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THE
SCIENCE
OF THE
CEREBRO-SPINAL PHENOMENA
ATTEMPTED.



PART I.

“ On répète aujourd’hui de toutes parts, et comme par écho, que les faits seuls constituent la science. Cette assertion banale exige cependant quelques explications. Suffit-il, en effet, d’avoir entassé des masses de faits pour avoir composé une science? Non sans doute: de même que l’on n’a pas construit un édifice pour avoir rassemblé les matériaux qui doivent servir à sa construction. Les faits particuliers sont les matériaux qui doivent composer l’édifice de la Médecine; mais ce sont des élémens épars, bruts, si l’on peut ainsi dire, qui doivent être réunis et rassemblés suivant certaines lois.”

BOUILLAUD, *de l’Encephalite, Preface.*

“ I think there is a want, not so much of facts in physiology, as of principles by which these facts ought to be connected, and by which the recollection and useful application of them may be best secured.”

DR ALISON, *Outlines of Physiology, Preface.*

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CEREBRO-SPINAL PHENOMENA

ATTEMPTED.

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PREFACE.

“ A PREFACE should contain nothing but the history of the book,” says Lessing. Were an ample detail to be given here, however, not only of the circumstances by which I was led to the composition of this work, but also of the various trains of thought which occurred in surmounting the difficulties which presented themselves, in the induction of the laws which it contains, the story would be fully as long as the work itself. Limited, as we are, for space, then, it may be proper here, only to offer some short apologies for the imperfections of the book, and to explain the manner in which the work is proposed to be completed and extended. In rendering a history of the induction, I had thought of expressing my obligations to the various authors to whom I have been indebted ; but, on more mature consideration, I think proper to defer such history and such acknowledgments to a future work, to which I flatter myself they will form an entertaining introduction.

Looking to its title, then—in the first place, the work is incomplete. The laws of the anatomy, physiology, and pathology of the apparatuses of assimilation, nutrition, and depuration, are altogether wanting. The *déal* portions of the apparatuses of perceptive consciousness have also been reserved.

Looking to its authorities—the work may appear sadly deficient in research. Had I been so foolish as to have attempted, with my present limited resources, a work on the elements of the physiology and pathology of the nervous systems of the human body, containing a detail of the opinions and doctrines of the

present day on these subjects, I might justly have exposed myself to the ridicule of the profession. A far heavier task than this was to be performed—a task which it required more than mere learning, or a knowledge of all other men's opinions, to accomplish. It was not long before I began to discover, that, however much I might benefit from the simple observations of others, I could derive little or no assistance from their theoretical counsels. I soon became assured, that if a victory was to be achieved, it could only be by a patience, a perseverance, and an obstinate resolution not to be overcome, such as no man before had ever thought it worth his while to bring to the field. Such indomitable perseverance, and such dogged resolution, were derived from an assurance that the cerebro-spinal apparatus, with its symmetrical appointments, being the contrivance of an Almighty Intelligence, could certainly not be the work of seeming confusion which the descriptions of lawless and unscientific anatomy present. I was confident, that, in the apparently complicated tracery of so nicely symmetrical a machine, there must be beautiful analogies in the dispositions of its lines,—there must be general laws, comprehending the distribution of filaments having analogous functions. Though baffled oft,—yet with the firm hope of ultimate success; under such persuasion, the combat with Anatomy and the Phenomena was continued, until those redoubtable enemies of Theory were at last overcome, and possession was obtained of the laws of their confederacy.

It is a remarkable fact, and worthy of a place in the history of the cerebro-spinal anatomy, that, having discovered a general law, I was able, on several occasions, to predict from it the ultimate destination of fasciculi, and much minute anatomy in the cerebro-spinal mass, of which I had been previously unaware, but the truth of which was afterwards confirmed by the descriptions of those who had no theories to support, but detailed, without prejudice, what they saw. The capability of such predictions is an attribute of true science. The law, that was derived from observations in one instance, and extended, by

analogy, to others, and found, by observations, to be true in these, was thus of great avail in successfully directing anatomical research to filamentous dispositions, of which, previously, there existed no satisfactory explanation. This was beautifully exemplified in the anatomy of the three independent divisions of the great re-entrant system of the ingenious Drs Gall and Spurzheim. The laws of transition of the unspecial perceptive oli-versal filaments, and of non-transition of the unspecial protective versal filaments, inducted by analogy from the laws of transition and of non-transition of the special filaments of the same orders, furnished me with a most satisfactory explanation, not only of the curvilinear lines on each side of the median line of the corpus callosum, but also of the lyre, and the longitudinal channels on the edges of the fornix — “the extremely delicate grooves,” noticed by Dr John Gordon “as running along the lateral borders;” as well as of the “slight furrow” “extending from the junction of the anterior pillars for about half way backwards along the median line, and then vanishing.” The unspecial protective versal filaments, conducting protective influence from the grey tissue of certain convolutions of the right and left cerebral hemispheres to the corresponding olivary ganglions, constitute those fasciculi which give to the edges of the right and left sides of the fornix that channeled appearance; because the course of such filaments, without transition across the median plane, is longitudinal, from the junction of the posterior pillars of this division of the great re-entrant system to its anterior pillars. The unspecial perceptive versal filaments, again, conducting perceptive influence from the grey tissue of certain convolutions of the right and left cerebral hemispheres, respectively to the left and right olivary ganglions, previously to having completed their transit across the median plane, obliterate, for a certain distance *sinciputad*, the median furrow of the fornix; while, after having completed such transit, and lying longitudinally in combination with the opposite protective versal filaments, they leave that median furrow manifest in its ante-

rior part. Many other instances might be adduced, where anatomical observation was directed by the discovery of a law ; but let these at present suffice. It has been here, as it was in Astronomy. The sublime application, by analogy, of the law which determined the velocity of the falling apple, to the instance of the moon in relation to the earth, and to that of the earth and other planets in relation to the sun, and the corroboration of the justice of such application by the recorded observations of celestial phenomena, led to established scientific formulæ, by which future phenomena are predicted, and future observations are directed. This was finely exemplified in the instance of the comet of Halley. Thus observations verified analogical induction ; while the formulæ derived from the latter, and successively corrected by the former, will in due time be found both to direct and correct observation.

It may be regretted by some, perhaps, that the laws in this work neither have received so extensive an illustration, in the explanation of phenomena, as could have been desired, nor have been sufficiently verified by induction from a more extensive collection of facts. To have fulfilled both these indications, however, the work must have been very extensive indeed, since the laws which it contains embrace such a vast number of phenomena. Besides, it must be considered how much the attention would have been distracted from a comprehensive contemplation of the series of propositions announcing such laws, if the recital of a great number of phenomena, and of other men's opinions, had been interspersed. Even in a future edition of this work, enlarged by such recital, and argumentative confutation of other men's theories, the annunciations of the laws will be still more compactly disposed, and still less separated than even here, by proofs and illustrations ; but each proposition will be taken apart, to form the head of a demonstrative and illustrative dissertation.

The novelty of its nomenclature, perhaps, may render this work unpleasing to some. Such novelty, however, was unavoid-

able, and by no means counselled by affectation. It must be recollected that objects cannot be precisely spoken of without being distinctly named. "Condillac has somewhere observed," says M. Bouillaud, "that the sciences resolve themselves into a well-constructed language. It may be said, with as much justice, that the sciences cannot have a well-constructed language, until the principal facts, of which they are composed, are well known. Medicine approaches that great epoch; this is the time to reform its language. But an enterprise so important requires the union of men endowed with high information, severe judgement, and a spirit elevated, philosophic, and free from all prejudice." To such high qualities as these I make no pretensions whatsoever; yet it is hoped that the nomenclature I have adopted will be found sufficiently elegant and simple. The names assigned to the primary ganglions of the cerebro-spinal apparatus, are those by which they are already well known; and, happily, they are such as afford abbreviations well adapted to combine with the epithets derived from the French words to denote the ordinal filaments which conduct influence to and from the primary cerebro-spinal centres.

From the compactness of its series of propositions, the work may at first appear to many heavy to be read, and difficult to be understood; but at length, after due perusal, the beautiful order and harmony, in which the anatomy and the phenomena rank themselves under the general laws, will, from such compactness, the more advantageously manifest themselves: until at last so clear, so extensive, so masterly a view be obtained of the anatomy, physiology, and pathology of the versal portions of the apparatuses of perceptive consciousness, both unspecial and special, as shall never more be forgotten. The student of medicine cannot think that a work containing the annunciation of the great laws of his art, may be perused like an idle tale of romance. But what constitutes the excellence even of a work of fancy, is its capability of being successively perused with fresh delight. A book, whether of science or of poetry, worthy only

of a single perusal, is but an insignificant work, bearing the impress neither of intelligence nor of high poetical fancy. The *Comus* of Milton may as frequently be read with poetical pleasure, as the *Principia* of Newton with intellectual profit. But let not the ardent student despair of arriving at a knowledge of the cerebro-spinal apparatus much greater than this work, even when completed, can impart. Though he may not be able at first to discover, all at once, the beautiful analogies, the symmetrical order, and the transcendental relations, which long-continued and severe study alone has enabled induction to mark out among the seemingly complicated tracery of the filaments of that apparatus; yet such analogies, such order, and such relations, will gradually in time, after having once been pointed out, arrange themselves in his memory with such precision, as ever afterwards to be easily turned to account in the direction of his future anatomical researches, and in the prediction of morbid phenomena from given lesions.

When the illustrious Sir Isaac Newton was asked "on some occasion, by what means he had arrived at his discoveries, he replied, 'By always thinking unto them;' and at another time he thus expressed his method of proceeding: 'I keep the subject constantly before me, and wait till the first dawnings open slowly by little and little into a full and clear light.' Again, in a letter to Dr Bentley, he says, 'If I have done the public any service this way, it is due to nothing but industry and patient thought.'" What made Raphael so transcendental a draughtsman? By frequently drawing unto it. How did Titian give to his canvass those traits of beauty? By frequently touching unto it. How came Cicero to order his thoughts and words to such persuasive eloquence? By frequently thinking, by frequently writing, and by frequently speaking unto it. After all, however, it must be allowed that intellectual strength prompts to intellectual industry. But intellectual strength may be increased by intellectual exercise; and, under all ordinary circumstances, it may be said in general, that the great secret of success in any research, is

frequently and continuously to recur to it, without fatiguing the organs of thought by too long exercise upon it at any one time. By attention to this the student will find, that his theme, instead of proving an irksome task, will rather be a delightful recreation; and in due course of time, he will be surprised at the clearness of his own views of a subject, which at first appeared so dark and mysterious. On every fresh contemplation, newer and truer views will present themselves; until at last the day dawn and the day-star arise in his heart, where before the light had shone only as in a dark place. Let him console himself with the assurance, that, when he has overcome one difficulty, he will be the more able to cope with the next; that the light, which he has been enabled to throw upon one dark place, will, by its reflection, still farther illumine all the rest. In the words of the illustrious author of the *Principia*, let the student keep the subject constantly before him, and wait till the first dawnings open slowly by little and little into a full and clear light.

I have already said that the work is incomplete, and I promised to point out the mode in which it was proposed to complete and extend it. Under the *déal* apparatus of the olivary and moriform ganglions, as far as that pertains to the functions of perceptive consciousness, the laws of that most intricate and interesting anatomy will be laid down, which explain the transition of the unspecial and special voluntarily musculo-contractile influence across the median plane of the cerebro-spinal system. Here, also, I shall take occasion to explain—in a manner which, it is hoped, will prove fully satisfactory—those cases in which the palsy is on the same side as the cerebro-spinal lesion, and which are said to afford exceptions to the general law of the transition of the influences above mentioned, as well as of the *déal* filaments which conduct them, across the median plane. Such cases offer no exceptions to the transition in question, which exists in every instance. The anomalous cases depend upon an altogether different cause. The laws of the anatomy and physiology of the apparatuses of assimilation, nutri-

tion, and depuration, will be inducted in a manner analogous to that in which the laws of the apparatuses of perceptive consciousness have been inducted in the present work.

Should life be spared, I flatter myself that I shall be able to make this future contemplated work as entertaining as easily understood. A scientific retrospection of the history of the anatomy, physiology, and pathology of the cerebro-spinal and sympathetic nervous systems, showing the erroneous methods of anatomical research and of physiological induction, and collecting, under the various scientific laws, the observations of different authors accordant with these, and thereby showing how such observations assisted in promoting the advancement of medical science;—what may be called the transcendental anatomy of the two systems of nerves, or the reasons of the various distribution of their filaments;—the relation of the former of these two systems to the latter;—the nervous systems of the different orders of animals, as contemplated under a knowledge of the scientific laws of the anatomy of the cerebro-spinal apparatus contained in this work when completed;—the laws of reaction of the primary ganglions, containing the fundamental principles of pathology and therapeutics,—will severally afford fertile sources of observations, not only entertaining to the general philosopher, but also highly useful to the practical physician, as embodying the scientific laws from which the rules of his noble art are derived. By that new method of exhibiting the anatomy of the encephalon,* which happily suggested itself in the course of these researches—that is, of representing surfaces by points, and whole fasciculi of filaments of the same function by single lines, projected on determinate planes—I hope, by well executed diagrams cut on wood, to make that anatomy as easily understood as the figures in plane geometry placed in the margins of its books.

The retrospect of the history of the anatomy of the cerebro-spi-

* Wherever this word occurs, it must be understood as denoting the whole cerebro-spinal mass, inclusive of the spinal cord.

nal apparatus will be rendered particularly interesting, as it will collect from all the best writers their anatomical observations, and arrange them as confirmative and illustrative of the general laws. Here due justice will be rendered to Reil, the Wenzels, Gall and Spurzheim, Serres, Bichat, Laurencet, Bellingeri, Rolando, Carus, Scarpa, Bell, Bock, Meckel, Soemmering, Vieq.-d'Azyr, Solly, Monro, Haller, and a number of others whose writings I have not been possessed of. The retrospect of the pathology of the encephalon will explain, according to the scientific laws of its anatomy and physiology, the various pathological phenomena arising from lesions either naturally or artificially induced, which are detailed in the records of medicine. I have said pathological phenomena; for as soon as a scalpel enters the skin of an animal, or it is subjected to any morbid irritant, the phenomena it exhibits are no longer physiological, but pathological phenomena. While such pathological phenomena will be attempted to be explained according to the laws of this completed work, the causes of the erroneous conclusions which these phenomena have often led to will also be rendered. "*La pathologie du cerveau, en particulier, réclame impérieusement de nouvelles recherches.*" *

The transcendental science of the anatomy of the encephalon will attempt to explain the reasons for the various laws already inducted, and to be inducted in the completion of this work, concerning the course and distribution of the several orders of filaments in the cerebro-spinal apparatus. Here the relation of the mechanism of this apparatus, to the functions which it is partly instrumental in accomplishing, will be pointed out—particularly the necessity and mode of the combination of the special with the unspecial versal fasciculi will be explained.

The relation of the cerebro-spinal to the sympathetic system of nerves will form a most profitable subject of dissertation. Such

* Bouillaud, *Encephalite*, Preface.

relation seems to be but too imperfectly understood. The most distinguished anatomists have differed in opinion respecting it. The opinion of Scarpa, for example, according to Beclard, is, that "the use of the (sympathetic) ganglia is to separate, mingle, and unite again the nervous filaments;" while Bichat, on the other hand, contends that these ganglions are independent nervous centres. The former is as certainly wrong as the latter is right. The distinguished anatomist of Italy seems to regard the sympathetic ganglions as plexuses of cerebro-spinal filaments. In this, however, with every deference to such high authority, it must be contended that he is entirely mistaken. It is submitted, that the characteristic between a cerebro-spinal plexus and a sympathetic ganglion lies here: in the former, the connexion between versal and déal filaments is not established; whereas, in the latter, it is. The dispute between distinguished anatomists upon this subject of controversy may, perhaps, be settled by a definition of a primary nervous centre. A primary ganglion, whether of the cerebro-spinal or sympathetic system of nerves, is the ultimate termination of versal filaments, the primary origin of déal filaments. It is the centre of union between versal and déal filaments. It is the final goal of the nervous influence arising from an impression of spirit or of matter, conducted by versal filaments from the grey tissue of the distal organ of such impression. It is the starting post of the influence going by déal filaments to the organ where such impression takes effect. Therefore, as long as its versal and déal filaments are left inviolate, a primary ganglion can still retain its functional powers, provided that it has within its own resources a sufficient quantity of nervous aura to accomplish the effects arising from the impressions made upon it. Let the sympathetic and cerebro-spinal ganglions be tried by this doctrine, and it will be found that the former are the more independent of the two. Let us deprive the sympathetic ganglions of the cerebro-spinal apparatus altogether, as has already been done to our hands in the fœtus of Mayer, where scarcely

a single vestige of that apparatus was found.* Here, by the arrangement and connexion of versal and déal filaments in the sympathetic ganglions, the different cavities of the heart were normally and rythmically contracted,—the unperistaltic contractions of the muscles of the arteries, and the peristaltic contractions of the œsophageal muscular apparatus of the capillaries, were effected,—and the nutritive functions were carried on—all from impressions of the aerated blood derived from the mother. Here were effects consequent upon impressions from the independent instrumentality of the sympathetic ganglions. But I appeal to every anatomist and physiologist, whether they ever saw any one function performed by the cerebro-spinal apparatus, without the presence of the sympathetic ganglion or ganglions pertaining to the plexuses of the arteries of the tissues of that apparatus; whether he ever saw a fœtus arrive at full maturity within the womb through the instrumentality of the cerebro-spinal apparatus alone, where the sympathetic ganglions, with their grey, and white medullary, filamentous appurtenances, were wanting. True, the sympathetic ganglions are incompetent in themselves, because they want nervous aura from their own resources, to contract the larger muscles from the impressions of spirit and of matter, and to stimulate the soul to perceptive impressibility of impressions; and, amidst the ever-varying vicissitudes of external matter, to preserve the tissues of the body from wreck: but yet these ganglions themselves are instrumental in the secretion of that very influence which augments their own functional powers.

Let the plexuses of the cerebro-spinal apparatus be tried by this standard of doctrine of a primary nervous centre, and it will be found that they have no claim to such a title. They are composed, indeed, of versal and déal filaments; but there is no connexion or anastomoses established between these, ordinarily

* J. L. Brachet, *Recherches Experimentales sur les Fonctions du Systeme Nerveux Ganglionaire*. A Paris, 1830, p. 65.

considered. Isolate the brachial plexus from the olivary and moriform ganglions, and the functions of the versal and déal filaments which enter it will be instantly abolished. No effect will follow upon an impression on its versal filaments. The influence arising from such impression, cannot pass into the corresponding déal filaments distributed upon the contractile organs of manifestation, because the connexion between the versal and déal filaments existed in the olivary and moriform ganglions. Certainly, the limb will move by irritating the grey cord which accompanies the déal filaments ; but the influence, arising from the grey tissue which accompanies such filaments, in this case, passes distad. Divide the spinal cord, and mechanically irritate the right abdominal extremity, and not only that but the left will manifest the contractile effect. But the movements are quite irregular ; they solely arise from the influence of the irritation being carried to the grey tissue in the centre of the spinal cord, and are not of that determinate and protective character, such as when they are effected through the instrumentality of the primary cerebro-spinal ganglions ; they are not such as are precisely adapted to remove the limb from the offending body. As to the ganglions of Gasser—being entirely composed of versal filaments, they have no right to such a designation, which should never have been applied to them in this work, had it not been for the sake of more clearly explaining the laws by those terms which were already in use. In a second edition, however, these ganglions shall receive another name. Medical philosophers have spoken unprecisely, for want of proper names for things according to their functions. The anatomy and physiology of the cerebro-spinal system have been much retarded in their scientific progress, for want of designations for its filaments, according as they conduct influence to or from the primary cerebro-spinal ganglions. There are other nerves than those of sensation, as they are called, which conduct influence proximad ; there are other nerves than those of motion, which conduct influence distad—to and from these ganglions.

Thus, then, there are only four cerebro-spinal ganglions, and the sympathetic ganglions, which deserve the title of primary ganglions : all other combinations of versal and déal filaments are merely plexuses. The only instance where a déal filament arises from a secondary ganglion, is in the fourth pair of nerves, which arise from the corpora quadrigemina.

The proper and scientific view, under which the cerebro-spinal system of nerves must be regarded, is as an apparatus, adapted for the secretion and transmission of a nervous aura, subservient to the sympathetic ganglions, as nervous centres, instrumental in the functions of perceptive consciousness, and of muscular contraction, arising from impressions of spirit and of matter ; and in the functions of assimilation, nutrition, and depuration, arising from material impressions alone—under the ever-varying conditions in which the body may be placed. The cerebro-spinal apparatus may be said to be a secretive and a conductive organization, grafted upon the sympathetic system of nerves, to enable this to produce effects, which, otherwise, it wants nervous aura from its own resources to accomplish. Without the aid of the cerebro-spinal apparatus, the sympathetic system of nerves is incapable of carrying on the nutritive functions, under the ever-varying vicissitudes of spiritual and material circumstances to which the human body is exposed. From the histories of anencephalous fœtuses which have arrived at maturity in the womb, without almost a vestige of the cerebro-spinal system of nerves, it would appear, that, under the equable temperature in which they are placed, and deriving aerated and nutritious blood, through the placenta, from the arteries of their parents, the sympathetic ganglions are fully competent to the circulatory and the nutritive processes. But the tissues, when exposed to the vicissitudes of our atmosphere, even although the respiration and circulation could be carried on, would soon go to wreck. What becomes of the lungs, isolated, in the lower animals, from the primary cerebro-spinal ganglions, by a section of the pneumo-gastric nerves?

The most philosophical view that can be taken of the cerebro-

spinal apparatus, is to regard it as an auxiliary instrument to the sympathetic ganglions, by means of which man is not only made conscious of the impressions of his own spirit and of matter, but also manifests his own perceptions and thoughts to other percipient beings; and by which the protective functions of muscular contraction, and of glandular secretion, and of assimilation, nutrition, and depuration, are partly carried on. But as the agent that acts with an instrument is not in it, but exists extrinsically of it; so neither is the spirit of man in any part of the whole cerebro-spinal system of nerves,—but exists in the sympathetic system to which that is subservient. In making this assertion, I know that the anatomy and the phenomena are both on my side, without the certificate of which every medical theorist should pause. “I feel a hesitation,” says our highly distinguished countryman, Sir Charles Bell, to whose ingenious observations I have already been much indebted in these researches, and shall be still more so in those which are to follow — “I feel a hesitation,” says he, “when I reason upon any other grounds than the facts of anatomy.”

It may contribute towards a tolerably clear view of the relation of the cerebro-spinal to the sympathetic system of nerves, if it be conceived, that from the grey tissue of the former, both unspecial and special, whether the latter be impressed or not, a flood of nervous aura constantly sets towards the sympathetic ganglions, successively in order along cerebro-ventral and cerebro-dorsal filaments. No influence, however, is sent from these latter ganglions to the cerebro-spinal, save that very little which is transmitted along the fasciculi of the ganglions of Gasser, and the congenerous fasciculi from the posterior columns of the spinal cord, and which is barely necessary to the protection of the organization of the tissues from which they proceed, and to the slight impressibility of such tissues as to touch. It is well known that every tissue in the animal frame, perhaps with the exception of the brain and cerebellum, is provided with such fasciculi; but they seem to be the most sparingly distributed to the sympa-

thetic ganglions of any tissue in the whole body, the brain and cerebellum only excepted. The cerebro-spinal influence passes into the sympathetic ganglions by the cerebro-déal filaments, which arise from the anterior column of the corresponding side of the spinal cord. As the anatomy of the nerves of the head has been the analogical model by which we have been able to induct that of the spinal cord; so that anatomy may also be taken as a model, by which to judge of the mode of communication of the cerebro-spinal with the sympathetic ganglions, as this communication regards one side of the spinal cord, and those sympathetic ganglions which receive fasciculi from it. The only versal filaments of the cerebro-spinal apparatus which conduct influence from the ophthalmic ganglion to the primary cerebro-spinal ganglions, are contained in a fasciculus of the corresponding ganglion of Gasser. But the ophthalmic ganglion is constantly receiving from the corresponding third nerve a large flow of nervous influence, as is every now and then manifested by the contractions of the iris. But when once the functional power of this ganglion is paralysed by the external administration of Belladonna, in vain the cerebro-spinal influence flows into that primary nervous centre, to contract the muscular curtain of the eye. Thus the right superior cervical ganglion is constantly receiving cerebro-spinal influence, by cerebro-déal filaments arising from the anterior column of the right side of the spinal cord. The transition of influence to and from every sympathetic ganglion, from and to its neighbouring congener, however, is equally free. Upon this depends the great law of physiological and of pathological sympathy of one organ with another through the whole body.

Some may be disposed to think, that the fasciculi, which proceed from the anterior branches alone of the spinal trunks to the corresponding sympathetic ganglions, are sympathetic fasciculi, accompanying those of the cerebro-spinal system to the organs of impression and of effect—the skin, the muscles, &c. But, if this were the case, why are such sympathetic fasciculi distributed

to the anterior branches alone of the spinal trunks, and not to the posterior branches also? These two branches, arising from the spinal trunks, formed of the unganglionated and ganglionated fasciculi of the spinal cord, have precisely analogous functions. Both are distributed upon the skin, as well as upon the muscles, &c.—only the anterior branches upon the forepart, the posterior branches upon the back part, of the trunk of the body. Certainly, the anterior branches alone of the spinal trunks contribute to form the cervical, the brachial, the lumbar, and the sacral plexuses; but this is an arrangement merely of local convenience,—the anterior branches being more adjacent to the sites of these plexuses, which are ventrad of the spinal column. It is submitted, then, that the anterior branches of the trunks of the spinal nerves send off fasciculi to the corresponding sympathetic ganglions, before such branches distribute their filaments in the cerebro-spinal plexuses above-mentioned. It is submitted, that these plexuses are entirely composed of cerebro-spinal filaments—that not a single sympathetic filament enters into their composition. It is submitted, that the cerebro-spinal and sympathetic systems of nerves do not primarily mingle their filaments in common in plexuses, but that each of these systems, first apart, forms its own. As the cerebro-spinal, cervical, brachial, lumbar, and sacral plexuses are altogether composed of cerebro-spinal versal and déal filaments; so the sympathetic solar and aortic plexuses are entirely composed of sympa-versal and sympa-déal filaments. True, the plexuses of both systems of nerves are distributed upon the same organs; but it is to be observed, that before they intermingle in passing to their common destination, they are distinctly formed; and the arrangements in each have respect to the primary ganglions of its own system alone, and the versal and déal filaments which proceed from these nervous centres. Thus the filaments of the cerebro-spinal pneumo-gastric nerves, and those of the sympathetic semilunar ganglion, separately form plexuses before passing to the organs of ultimate distribution. Thus the filaments of the cerebro-spinal sacral

nerves, and those of the sympathetic lumbar ganglions, form the cerebro-spinal sacral and the sympathetic aortic plexuses apart : while these plexuses, again, send filaments to form secondary plexuses, to accompany the arterics of the organs on which they are both distributed. The hepatic plexus is formed in this way, as is also the hypo-gastric.

The cerebro-spinal influence, flowing by cerebro-déal filaments into the sympathetic ganglions, is entirely unspecial as to the functions of these centres. The arrangement and connexion of sympa-versal and of sympa-déal filaments in a sympathetic ganglion, are altogether independent of the cerebro-spinal fasciculus, which conducts such unspecial influence to such ganglion. The connexion of the sympa-versal and sympa-déal filaments of the solar plexus in the semilunar ganglion, is entirely independent, it is presumed, of the déal filaments of the pneumo-gastric nerves, which conduct unspecial influence into this great sympathetic nervous centre. The connexion of the sympa-versal and sympa-déal filaments of the plexus of the right internal carotid in the superior cervical ganglion, is quite independent, it is presumed, of the fasciculi from the anterior branches of the cervical nerves. The connexion of the sympa-versal and sympa-déal filaments, constituting the sympathetic aortic plexus, in the lumbar sympathetic ganglions, is quite independent of the cerebro-spinal fasciculi, from the anterior branches of the lumbar nerves, entering these nervous centres.

As the pneumo-gastric nerves are analogous to the spinal nerves, in composition, and in function ; so the mode in which the former communicate influence to the semilunar ganglion, is analogous to that in which the latter communicate with the corresponding sympathetic ganglions. I have not space to dwell upon the application of these truths to pathological reasoning, and to the direction of pathological experiments. It is lamentable to think how recklessly these latter have often been gone about. According to these views, if the pneumo-gastric nerves be divided, the functional powers of the semilunar ganglion will

be greatly impaired for want of unspecial influence from the grey tissue of the cerebro-spinal apparatus, and the organs upon which the filaments of that ganglion are distributed will be deprived of their impressibility as to touch ; but still the sympathetic apparatus will be entire in its versal, its central, and its déal appointments, to carry on, in some degree, its functions, provided that the tissues, upon which its filaments are distributed, could be preserved from wreck on account of the loss of the cerebro-spinal unspecial influence.

It is a remarkable fact, that there is not a single organ of effect contained in the whole cerebro-spinal apparatus, nor a single phenomena produced by the instrumentality of it alone. From the impressions of spirit and of matter upon the grey tissue of the cerebro-spinal apparatus, a certain quantity of nervous aura is generated, which being conducted along certain medullary filaments, serves to stimulate the sympathetic ganglions to a due performance of their functions. But, from such impressions upon such grey tissue, neither the nervous aura can be generated, nor, when generated, and conducted to its ultimate destination in the cerebro-spinal apparatus along cerebro-spinal medullary filaments, can it take due effect, without the instrumentality of the sympathetic ganglions. In order duly to perceive a spiritual or a material impression, the soul in its organ, a sympathetic ganglion, requires to be duly stimulated by a flood of nervous aura secreted in the grey tissue, both unspecial and special, of the cerebro-spinal apparatus. Before sympathetic ganglions, also, can contract one of the larger muscles, a flood of nervous influence must be sent from the same tissue along the cerebro-spinal medullary filaments, duly to stimulate such ganglions through the medium of their grey sympa-versal filaments, forming a part of the nervous plexuses of the arteries of such muscle.

The light may impress the right retina, for example ; but it is only through the instrumentality of the right superior cervical ganglion, whose filaments, in a plexus, surround the right ophthalmic artery—a branch of the right internal carotid—that the

special perceptive influence can be eliminated from the blood in the capillaries of that distal organ of impression of the right half of the optic apparatus,—and the unspecial perceptive influence from the grey tissue of the convolutions of the right cerebral hemisphere,—both simultaneously to be transmitted to the organ of perceptive consciousness, the semilunar ganglion, as will afterwards be shewn.

Is the forefinger, for example, of the left hand, to be bent by a selective impression of the spirit upon a particular patch of the grey tissue of the right optic thalamus? Then, not only is the special influence eliminated from the blood in the capillaries of that patch, by the instrumentality of the right superior cervical ganglion, and its filaments distributed upon the branch of the right internal carotid artery supplying that patch; but, when the same influence reaches the capillaries of the muscles of the little member, it is only through the instrumentality of the sympathetic ganglions, whose filaments, in plexuses, surround the arteries of these muscles, that they are ultimately contracted. Sir Astley Cooper, by his very important experiment of including and excluding the sympathetic aortic plexus, in his ligature around the aorta of a dog, has taught us that the sympathetic ganglions, whose filaments, in plexuses, surround the arteries and capillaries of a muscle, are as absolutely necessary to its contraction as the cerebro-déal musculo-contractive filaments.

It is seemingly from the semilunar ganglion, the organ of perceptive consciousness—as will in the future part of this work be attempted to be shown—that the influence primarily originates, by which the intellectually selective impressions are made by the spirit upon the grey tissue of the corpora striata and optic thalami, which are subservient, not only to voluntary muscular contraction, but also to memory and fancy. Thus to this great centre of the sympathetic system the perceptive influence, arising from the impressions of matter and of spirit, flows as to a common goal; and from the same centre the influence emanates, by which those muscular contractions are effected, that manifest to

other percipient beings the consciousness of such impressions, and that change the place of the body in space, and supply its wants.

There are many anatomical, physiological, and pathological considerations in support of the semilunar ganglion being the organ of residence of the soul of man, or where this is impressed by the perceptive influence, which I have not space here to dwell upon. That the soul of man, or the intellectual agent, resides somewhere about the præcordial region, has not only been the expressed opinion of divinely inspired men, but also a tenet of some of the sects of the ancient heathen philosophers. "Keep the heart with all diligence," (or, as it is in the margin of our Bibles, "above all keeping,") says the divinely inspired and Royal Preacher, "for out of it are the issues of life." Again, says the Great Creator himself, through his sublime prophet Isaiah—"For, behold, I create new heavens, and a new earth: and the former shall not be remembered, nor come into mind"—"nor come upon the heart," as it is in the margin. "Eye hath not seen, nor ear heard, neither have entered into the heart of man," says the Apostle of the Gentiles. Such doctrines of the mode in which memory, fancy, and other phenomena of thought, are effected, it will be seen are entirely in accordance with the independent faculty of the spirit, whereby it can remember former impressions, and combine them anew. According to the doctrine here laid down, the spirit is the treasurer of its ideas, derived from its own impressions, and those of matter, which it combines of itself without the aid of any material apparatus, before making those intellectually selective impressions, by which memory and fancy are effected. Before intellectually selective impressions can be made upon the grey tissue of the corpora striata and optic thalami, subservient to perceptive consciousness, constituting either the memory of an object formerly seen, for example, or presently fancied, the picture must be known to the spirit. As the material objects which are seen, are already externally arranged in the same correlative order in which they are painted upon the retinæ; so, the objects remembered or fan-

ciated are already arranged, by the spirit, in the same correlative order in which those selective impressions of the spirit are made upon the grey tissue of both corpora striata, by which the secretions are effected which are identical with those produced by the variously coloured pencils of light, which, impinging upon both retinæ, would cause the vision of these objects. Surely it is preposterous to imagine, that the impression formerly made by the varied secretions of the symmetrical patches of the two retinæ, from the impingement upon them of the differently coloured pencils of light, can remain upon an animal tissue, whose material elements are constantly undergoing renovation. The image must be remembered by the spirit, independently of every material apparatus; and the consciousness of the same image, whether alone or in combination with others, must be manifested to the soul of man by intellectually selective impressions of the spirit, simultaneously made upon symmetrically disposed patches of the grey tissue of the distal organs of the apparatuses of memory and fancy: just as the sight of the material object remembered or fancied, would be originally effected by material impressions upon the retinæ. The special perceptive versal appurtenances to the grey tissue of the corpora striata and optic thalami, are perfectly analogous to the special perceptive versal appurtenances of the retinæ, and conformable to the same laws of transition across the median plane of the cerebro-spinal apparatus, and of combination with the unspecial perceptive oliv-ersal fasciculi. The varied secretions arising from the impingements of the differently coloured pencils of light from the different points of the material object formerly seen, are precisely the same as the varied secretions arising from the selective impressions of the spirit subservient to the present memory of that object. The medullary conduits, which conduct these two orders of varied secretions from the grey tissue of the analogous organs of impression, are also analogous in their courses, and they convey the glandular products to the same ultimate destination—the semilunar ganglion—there to impress the soul of man. As the por-

tions of grey tissue at the bottoms of the eyes are the retinae for material impressions subservient to sight; so the portions of grey tissue of the corpora striata or optic thalami, on both sides, are the retinae for spiritual impressions subservient to memory and fancy. As the special perceptive oli-versal fasciculi, passing from the bottoms of the eyes, and crossing the median plane of the cerebro-spinal apparatus at their commissure, to join the unspecial perceptive oli-versal fasciculi at the inner edges of the opposite crura cerebri, to pass along with these to the opposite olivary ganglions, are the optic nerves of sight; so the special perceptive oli-versal fasciculi from the grey tissue of the corpora striata or optic thalami on both sides, crossing the median plane, respectively at the anterior and the posterior commissures, to join the unspecial perceptive oli-versal fasciculi at the inner edges of the opposite crura cerebri, and so, in conjunction with these, to reach the opposite olivary ganglions, are the optic nerves of memory and of fancy. Now, it is not difficult to conceive the mode in which the spirit eliminates such varied secretions from the correlative points of the symmetrically disposed patches of grey tissue of the corpora striata or optic thalami. The eliminating influence may be transmitted from the semilunar ganglion along the sympathetic ganglions, on both sides, from one to another, till that influence reaches the two superior cervical ganglions, from which, again, it may be sent by sympa-déal white medullary filaments, constituting parts of the plexuses of the internal carotid arteries, the capillaries of some one of whose branches are distributed upon the patches of the spiritual retinae of memory and fancy in question.

Thus, according to these views, we see how beautifully this idea of secretion explains the phenomena of the nervous system. Thus we see how equally independent spirit and matter are of the apparatuses of perceptive consciousness, by which they manifest themselves to man, and other percipient beings. Thus we see that the cerebro-spinal system in man is a symmetrical apparatus, beautifully adapted for the manifestation of the exist-

ence and operations of spirit and of matter to his soul. The great centre of the sympathetic system of nerves, in this way, is the organ of residence of the intellectual percipient in man and the lower animals, whither the influence arising from spiritual and material impressions upon the distal organs of impression of the cerebro-spinal apparatus flows; and whence the influence proceeds, by which a consciousness of those impressions is manifested to other men and animals, and the condition of the body is changed, according to the perception of its ever-varying circumstances. It is from the centre of this most original and longest persistent system of nerves, that the influence emanates, by which tissues are more or less perfectly reformed—the lost toe of the shell-fish, the lost eye of the water-newt, are created anew. Such renovation, according to the usual mode of operation of the Almighty Spirit of Nature, is a work of time. But this Great Being is not the slave of his own laws. What he is pleased to do by slow degrees in a month, he can, with equal ease, perform in a moment of time. The material manifestation of the Creator of the universe that visited this earth, restored the injured tissues of the human eye while he uttered the words of his power.

Such doctrines concerning the organ of perceptive consciousness, are at direct variance with some conclusions lately attempted to be established from experiments upon animals,—but not with the phenomena arising from them. M. Flourens has recently attempted to shew, that the organ of perceptive consciousness is in the cerebral hemispheres. In this, however, it is submitted that he must be entirely mistaken. Because perceptive consciousness is found to be abolished, when means are taken either to remove the unspecial grey tissue on the convolutions of the cerebral hemispheres, where unspecial perceptive influence is secreted,—or, after it is secreted, to stop it in its course to the organ of effect, where it impresses the anima of an animal;—that is no argument that such organ of effect lies either in the productive tissue, or in the medullary filaments which conduct

the influence away from it. Let all the grey tissue be pared from the convoluted surface of the brain of this dog. See, now, he is comatose. As long as one perceptive function remained, all remained; when one is lost, all are lost. No wonder. This tissue was necessary to the production of the unspecial perceptive influence, without the instrumentality of which the special influence, arising from the impressions of spirit and of matter upon the grey tissue of the distal organs of impression of the apparatuses of perceptive consciousness, could not take due effect. Or, snip in two, if you are able, the unspecial perceptive fasciculi, as they lie at the inner edges of the crura cerebri; then the same comatose state obtains. No wonder. You have, indeed, left the organ of production of the unspecial perceptive influence inviolate in its secretive function; that influence is still generated; but you have destroyed and broken up the medullary conduits, which conduct it to its organ of effect, so that it can no longer pass on to impress the anima of the brute. See this little drawing. Here is the boiler of a small steam-engine, with a small pipe affixed, at the end of which I place the nose of this dog, and call him the soul or percipient thing of this engine. Now, the steam being raised, the animal gives a most lamentable yammer. The soul feels the influence produced from the water in the boiler, and transmitted along the pipe. The fire is removed; the steam is no longer produced; the soul is conscious of nothing. I have abolished the function of the organ productive of the influence which took perceptive effect. Now, again, the steam is up once more; but I have interposed this valve to stop its progress in the pipe. It can no longer reach the nose of the representative; he is in a comatose state; he "gives no sign." How say you, then? Is the organ of perceptive effect in the boiler, or in the pipe between the boiler and the valve? No, certainly: the organ of effect, where the influence impresses the percipient being, independently of both boiler and pipe, is at the very end of the pipe, where it meets the nose of the sufferer.

When you pare off the unspecial grey tissue secreting an in-

fluence subservient to perceptive consciousness, it is as if you stopped the production of the steam altogether. When you cut both *crura cerebri*, containing the unspecial perceptive *oli-versal fasciculi*, conducting the unspecial influence away to impress the *anima* of the dog in the organ of perceptive effect, it is as if you put a valve in the steam pipe—you interrupt the nervous influence in its course to the percipient being to be impressed.

When it is known, that from every point of the surface of the cerebral hemispheres, the flow of the influence is towards the *olivary ganglions*; and that the *sinciputal peduncles* of the *moriform ganglions*, which are commonly called the pillars of the *Vieussenian valve*, are, with the exception of the fourth pair of nerves, entirely composed of special *versal filaments*; and that no *déal filaments* are to be found in the *sinciputal peduncles* of the *olivary ganglions*, or what are commonly called the *crura cerebri*, with the exception of the third pair of nerves;—how, then, can it be conceived that the special perceptive influence, passing proximad to the primary *olivary ganglions* from the skin of the thoracic and abdominal extremities, should reach, by *medullary filaments*, an organ in the cerebral hemispheres? It is a great law, in both the sympathetic and cerebro-spinal systems of nerves, that no effect is ever found to be produced between an organ of impression and a ganglion, or in a *versal fasciculus*. Every organ of effect is either a sympathetic ganglion, or else it is placed at the extremities of cerebro-*déal* and sympa-*déal fasciculi*. The perceptive influence, both unspecial and special, has already been traced respectively from the unspecial grey tissue covering the convolutions of the brain, and from the special grey tissue at the distal organs of impression of the apparatuses of perceptive consciousness, by *medullary filaments*, passing, according to general laws, to the *olivary ganglions* sacred of what are properly called the cerebral hemispheres and the *crura cerebri*, properly speaking. From these ganglions the perceptive influence must pass into the sympathetic system of nerves by some of those cerebro-*déal filaments* which

arise from the anterior columns of the most atlantal portion of the spinal cord; for it is found that this cord may be divided very high, and yet the parts of the body sending perceptive fasciculi to it above the point of section, still retain their impressibility as to touch. It is, therefore, probable that the cerebro-décal filaments conducting the perceptive influence to the semilunar ganglion, may enter the sympathetic system by the superior cervical ganglions.

The modifications of the different laws laid down in this work, according as they are found to apply to the different orders of animals, will form a very interesting subject of study. While it is expected that these laws will throw great light upon the study of the comparative anatomy of the nervous system, they will, in their turn, be beautifully verified by its observations. As we descend in the scale of organized life, this great and fundamental principle in its economy will be illustrated—viz. that from man, the highest terrestrial animal, to the highest vegetable, the apparatuses whereby spirit and matter are manifested to the individual, are successively becoming impaired in the number, delicacy, and perfection of their functional powers, until in the latter such apparatuses cease to be found. Here the principle will be explained, that the nervous system which is the longest persistent, is the most absolutely necessary to the maintenance of life, and contains the organs of greatest importance.

But of all the several subjects of dissertation in this future contemplated work, that of the laws of reaction of the primary ganglions of the nervous systems of the human body, will be by far the most fertile in useful results to the practical physician. These laws will not only explain the modes in which many morbid phenomena are produced by pathological impressions from spirit and from matter, but also point out the reaction of the same nervous centres which ought to be excited for the removal of such phenomena. In this dissertation I propose to collect, under the several laws just mentioned, many of the leading phenomena of diseases, as well as the phenomena arising from the

action of many therapeutical agents. When we reflect that the nervous influence, by which the capillaries of tissues circulate their contents, and eliminate from these the various glandular products, is originally derived from the primary ganglions, whose filaments, in plexuses, are ramified around the arteries,—then, surely, it behoves us to endeavour to explain the abnormal state of the circulatory and secretive functions of those vessels by morbid impressions carried to such primary nervous centres, and to seek to remove such state also by pathological impressions from therapeutical agents. Thus, by the pathological consequences arising from the impression of one set of agents, which are called remedial, we endeavour to obviate pathological consequences, which have arisen from the impressions of another set of agents, which we name morbid. There is none of the homeopathic doctrine, however, intended here. Where medicines, in their ordinary doses, are found to be truly efficient in the cure of disease, their beneficial effects will be attempted to be explained from the scientific laws of reaction of the primary ganglions. It will then be seen, whether the theory of medicine is of any utility in devising successful means for the removal of morbid phenomena,—whether the art of medicine is altogether empirical, or deducible, to some very considerable extent, from established laws inducted from observation.

Previously to having devoted any very particular attention to the anatomy and physiology of the cerebro-spinal system of nerves, I had undertaken, and made some progress in, a work, wherein I attempted to explain the phenomena of diseases, and the action of remedies, according to the laws of reaction of the primary sympathetic ganglions; but I soon began to discover, that, without a thorough change in that anatomy and physiology, any theory of medicine would be very imperfect indeed. That work was therefore suspended; and, from a comprehensive contemplation of anatomical facts, I sought to discover, by analogies and other means, first the laws of the anatomy, and afterwards those of the physiology, of the cerebro-spinal system of nerves.

Having thus offered some apologies for the imperfections of this work, and, as briefly as possible, explained the way in which it is proposed to be completed and extended,—offering a few observations, at the same time, upon the relation of the cerebro-spinal to the sympathetic system of nerves,—it now only remains for me to say a few words upon a subject which is ever dear to my heart—I mean the vindication of the philosophy of the Bible, physiologically speaking, as it regards the nature of man.

It has been said that thought is merely a secretion from the glandular tissue of the cerebro-spinal apparatus, just as bile is a secretion from the capillaries of the liver. It is fondly hoped, however, that, after the perusal of this work, physiologists, who still entertain such an opinion, will confess that they have erred without knowledge. When organs of impression have been pointed out in the human brain, possessing conductive appurtenances, analogous to those of such organs, subservient to perceptive consciousness from material impressions, the natural conclusion is, that the former organs are designed to receive selective impressions from some intellectual agent, and that the phenomena of thought are effected in an otherwise manner than the eliminations of any glandular product from the blood. It is submitted that such physiologists have mistaken the nervous influence, which is only subservient to the production of the phenomena of thought, for these phenomena themselves. As the nervous aura arising from material impressions upon the grey tissue of the distal organs of impression of the apparatuses of smell, sight, &c., being conveyed by medullary filaments to the organ of perceptive consciousness, produces perception of material objects; so the nervous aura arising from spiritual impressions upon the grey tissue of the corpora striata or optic thalami—the distal organs of impression of memory and fancy—being conveyed by medullary filaments to the same organ, produces perception of spiritual objects, or thought. The nervous aura, in either case, is merely the intermediate moveable medium, by which the impressing agent, whether spirit or matter, affects the percipient

spirit or soul of man. The impressing spirit or matter, and the percipient soul, are equally independent of the apparatus by which the two former impress, and the nervous influence by which the latter is impressed. When a selective impression, subservient to determinate muscular contraction, is made by the spirit upon the grey tissue, for example, of the right corpus striatum, the capillaries are thrown into secretive action only of that patch of grey tissue which is immediately connected with the fasciculus of cerebro-spinal medullary filaments ultimately terminating in the muscles of the left abdominal extremity, to be contracted to execute the remembered motion; but, from the action of the chyme in the duodenum upon the grey sympa-versal filaments of the semilunar ganglion, an influence from this great sympathetic centre flows simultaneously and equally, it is presumed, through all its sympa-déal medullary filaments, to excite a secretive act in the whole of the hepatic capillaries of the portal vein. There is no intellectually selective operation manifested in this latter case, as it is in the former.

The motions of the alimentary mass, through the æsophagus and stomach, are, indeed, determined by its impressions; for here the impressing body is the one to be acted upon; and the nervous and muscular apparatuses are so designed, that the place of impression is also that of impulsion. In the case of locomotion, however, arising from contraction of the muscles of the left abdominal extremity, from selective impressions of the spirit upon the grey tissue of the right corpus striatum, the impressing agent is impalpable, and totally distinct, in its nature and locality, from the body to be moved. The organ of impression is at a distance from the organ of effect. There is no manifestation of intelligence in the random impressions of the brute material mass. Wherever it impinges, the appointments of the nervous and muscular apparatuses are so contrived as to convey it to its proper destination; the motion is that of a vegetable. But the spirit, that, by its selective eliminations of nervous influence from the grey tissue of the right corpus striatum, causes motions in

the left abdominal extremity, determined by previous perceptions, is possessed of a knowledge of the structure of man infinitely surpassing that of which man himself was ever conscious. How justly has the Apostle of the Gentiles said, "What man knoweth the things of a man, save the spirit of man which is in him!"

It may be said that I have made the Bible a little inconsistent with itself, when it is said, in one place, that the intellectual agent which selectively impresses the grey tissue of the corpora striata and optie thalami, resides in the blood,—and in another, that it resides in the heart or semilunar ganglion. But, upon due reflection, it will be found that such is not the case. I cannot conceive of the spirit residing any where. All that can be said is, that the semilunar ganglion is the last organ, whither the nervous influence which impresses the spirit can be traced along conductive medullary filaments, and is the organ impressed by the spirit, in its turn, by which it manifests to man, and other percipient beings, its own perceptions and thoughts, and changes the place of his body in space, and administers to its wants. The spirit may still reside in the blood, and still the semilunar ganglion may be the last solid organ from whence the nervous influence passes to impress that intellectual being in the vital fluid. How can any condition be conceived to be inconsistent with the nature of a thing which has never been perceived?

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THE
SCIENCE
OF THE
CEREBRO-SPINAL PHENOMENA
ATTEMPTED.

INTRODUCTION.

IT is needless to dwell at any length upon the vast importance of studying the laws of reaction of the cerebro-spinal and sympathetic nervous centres. When the medical philosopher reflects that every phenomenon in the animal economy is regulated by these laws, he must be duly impressed with the urgent necessity of endeavouring to deduce them from the various conditions of animal life which nature and art present to his observation and study. Deprived of the influence of the nervous centres, what but an inert and unproductive mass would be every organ of the animal frame? Isolate its arteries, capillaries, veins, and absorbents from the sympathetic and cerebro-spinal ganglions, and its function is lost, whether to impressions of spirit or of matter. Through the agency of the Almighty Being that pervades the universe, it is in the capillaries more

immediately that every animal lives, and moves, and has its being. But in whatsoever mode, and by whatsoever influence, these vessels circulate their contents, and eliminate from them the various glandular products; whenever, by either natural or artificial obstructions, they are deprived of that something which they derive from the sympathetic and cerebro-spinal ganglions, they instantly become incompetent to their duty, the blood stagnates and coagulates within their walls, and mortification takes place. Are they distributed upon a muscle? then its fibres are no longer contractile, either from the impression of the soul or from that of matter. Are they ramified through a gland? then blood is the only product which flows through its conduit. Do they supply the grey tissue of an organ of impression subservient to perceptive consciousness? then that organ is no longer impressible to such effect. Though the blood seems to have something within itself which forms it into blood-vessels when lying in contact with a living tissue, yet deprive this tissue of the influence from both classes of nervous centres, and there is every reason to believe that no such organization of the effused coagulable lymph will happen. Because some tumors, when cut into, seem not to be impressible as to consciousness of pain, this is no proof that their blood-vessels are destitute of nervous filaments. Those of the sympathetic system may be there, which, from the experiments of M. Brachet, have been found unimpressible as to pain when repeatedly irritated, provided they have been isolated from the cerebro-spinal system. Such a tumor may be in the same condition, as to the nervous system of its blood-vessels, as the anencephalous foetus in the womb of its mother, nourished by the sympathetic system of nerves alone. In the animal

body it is absurd to talk of a *solidum vivum* or a *fluidum vivum*. The blood in its capillaries, isolated from the nervous centres, can give rise to no phenomena. Neither, without an organised fluid circulating through them, can the ganglions react. Before ever the heart can propel the blood contained in it, the cardiac sympathetic ganglion must be formed, to supply the muscular fibres of that organ with its filaments,—without which, notwithstanding the stimulus of the vital fluid, they cannot contract. Indeed, the impression of the blood must first be carried to this ganglion by one set of filaments, and an influence again transmitted from this centre to these muscular fibres. “We shall be still more confirmed in our opinion, [viz. that it is the sympathetic ganglionic system which is the vital cause of the movement of the heart,] if we consider,” says M. Brachet, “that the nervous system begins with the cardiac ganglion, as Ackermann has observed, and as Malpighi had observed before him, giving to that ganglion the name of *quille*, and considering it in conjunction with the spinal marrow, which he regarded as the root of the animal; moreover, if we consider that the great sympathetic is developed afterwards, and that the heart, the first organ that enters into action, never exists without this ganglion, whilst the spinal marrow is often wanting; lastly, if we add, that this nerve is more developed in the anencephalous monsters than in the well-formed fœtuses—a proof that it does not derive its roots from the spinal marrow, according to Legollois.”

The necessity of studying the primary centres of the cerebro-spinal system of nerves presents itself to the physician under four points of view, as he is at once an anatomist, a physiologist, a pathologist, and a therapeutician. It is only by the study of

this system in relation to its primary ganglions that the true principles of its structure can be fundamentally understood, and the mingled distribution of its filaments be scientifically demonstrated. Anatomy, physiology, and pathology, throwing their several lights together upon the seemingly complicated network of the cerebro-spinal apparatus, may, by such a method of study as this, at last discover the simple plan that the Almighty Author of Nature has followed in its design. It may not, perhaps, be too much to hope, that, at a day not very far distant, the medical philosopher, from a few anatomical, physiological, and pathological observations, may gather the true science of the whole. Then only will it be discovered how simple and how harmonious that structure is, which now wears the appearance of so much complexity. Then only will the different classes and orders and genera and species of nerves be known; which supply every organ in the animal economy; what is the function of each different filament; and from what primary centre or ganglion it is derived. Then only will the memories of the physiologist and pathologist be swept of that laborious and cumbersome nomenclature, with which the anatomical description of the cerebro-spinal masses, as well as their ramifications, is loaded, and a more scientific one, better conformed to the functions of organs, be substituted in its stead. By both anatomist and pathologist, as well as physiologist, the structure and distribution of the cerebro-spinal apparatus should be studied in reference to the functions of its organs. It is only in this way that the anatomist can be guided in his further researches, and can confirm the truth of the results of his dissections, and the pathologist predict the consequences of given lesions. Why should the soul of the student

be perplexed to figure forth the airy space of a lateral ventricle ! There is no function in that, or in a third or a fourth ventricle either. What need of a tedious and minute description of the laminæ of the cerebellum, any more than of the convolutions of the brain ? By the undulated figuration in both, the grey tissue is so disposed that a greater surface of it is brought into contact with the extremities of the medullary filaments which conduct away the influence that is eliminated from the blood in that glandular organisation. The convolutions and laminæ have no particular functions, but are only generally subservient to those of the primary cerebro-spinal ganglions to which they respectively appertain.

Physiology is the science of healthy phenomena ; but to a knowledge of this science the physician cannot lay claim, until he discover the nervous centres on whose reactions the functions of organs depend, as well as the localities of those parts of the cerebro-spinal apparatus where the impressions are made which excite such reactions.

Surely, too, if the disorders of functions, and the diseases of their organs, depend, as will be shewn, on an aberration of the nervous centres, whose filaments supply them, from their normal reaction, it must be of the greatest consequence to the pathologist, as well as to the therapeutician, to know the positions of these centres, and the various nervous filaments with which they are connected. It is only by such knowledge that the former can render a just explanation of the phenomena of disease, and the latter apply his remedies to the best advantage.

But, alas for the science of medicine, from the nature of its object it is doomed to be ever imperfect. The functions of life

are carried on in capillary vessels, whose structure, even with the microscope, we cannot discover, and whose changes are mostly hidden from our observation. Most of our reasonings concerning the mechanical and electro-chemical states of such vessels must, therefore, be, in a great measure, from analogy and speculation. And even although, with optical assistance, we could observe, we could not measure the extent of their contractions under different given circumstances, and, therefore, could not, by algebraical formulæ, express the reactions of the nervous centres from which such contractions arise. But granting that we could do this, the matter imbued with life varies in its reaction according to so many ever-varying causes, that no law could be applicable to more than one individual, and even to him only for a very limited time. If there be so much reason, then, to believe, that the mechanical changes of capillary vessels, under the operation of given stimulants, will never be objects of exact science, so as to be predicted with certainty, there is still less reason to believe that the electro-chemical changes of such vessels will ever be so. We cannot reach the organs of the living animal with our electrometers, even were these sufficiently delicate to communicate such information. We can, therefore, only judge of the condition in question, by the quantity or quality of the products to which it gives rise, and even these we often cannot conveniently gauge.

“ *Nemo naturæ studiosus nescit in quantis tenebris etiam brutæ hujus telluris scientia jaceat,*” says Dr Heberden, “ *et quam parum adhuc profecerimus in cognitione rerum inanimatarum. At vero in corporis humani scientia, et eadem omnia, et multa præterea, quæ sunt animantium propria, nos latent.*”

Etenim corporis leges sunt multo plures, et longe aliæ, quam quibus res inanimatæ subjiciuntur ; neque harum modus, et conditiones, ad actiones vitales explicandas sufficiunt, aut ad animantia recte transferri possunt. Quamobrem usum, tardum sane ducem, fere solum huc usque secuta est ars medendi ; et nulla illustria incrementa ex ratione vel cepit, vel captura est, donec humano generi a Deo immortalis tributus fuerit vir, qui, quemadmodum Newtonus inanimata, sic animantia contemplando, principium illud vitæ detegat, a quo omnes naturales actiones pendent, et gubernantur."

Such a Newton, however, of living matter, as here contemplated, can never arise. Our illustrious Newton, who taught us the application of the law of gravity to explain the phenomena of the heavens, could, by palpable measures, ascertain the effects to which it gives rise, and so predict the trajectories in space which it rules ; but what means shall human intellect ever devise to measure the mechanical or electro-chemical conditions of the capillaries of a secreting organ, produced by healthy stimulants or morbid irritants acting upon the animal frame, or the varied products arising from such vascular conditions ?

" Verum enimvero non ideo concludere fas est," we may justly say with Dr Gregory, " nihil veri aut certi de *Theoria* artis medicæ unquam repertum iri ; neque si aliquid tale repertum fuerit, idem inutile futurum. Plurimas alias artes, bene novimus, detectis philosophorum industria veris quibus nitebantur principiis, illico multum propectas esse. Quod profecto magnus olim Bacon, veræ philosophiæ naturalis auctor atque parens, solita sua sagacitate, et perspexit et prædixit. ' Interim (inquit) nemo expectet magnum progressum in scientiis, (præsertim in

partee arum operativa), nisi philosophia naturalis ad scientias particulares producta fuerit, et scientiæ particulares rursus ad naturalem philosophiam reductæ. Itaque non mirum est si scientiæ non crescant, cum a radicibus suis sint separatæ.'” At all events, let us console ourselves with the observation of Gaubius, that “inter multiplices theorias vix unam esse tam omni ex parte falsam, ut non aliquid veri habeat.”

Let us be persuaded, then, that the endeavour after as perfect a theory of medicine as possible, is neither an idle nor an unprofitable quest. It is the possession of this alone which can give us confidence at the bedsides of our patients when anomalous phenomena arise. It is this alone which can raise us above the level of mere routiniers or mere book-practitioners, blown about by every wind of doctrine. He who best knows the various reactions by which the organs of the body have aberrated from health, knows also best how, by gentler reactions of a different sort, to reduce these organs again to their normal condition.

But let us not deceive ourselves. We must not imagine that morbid phenomena can always be easily explained, with little serious study. The scientific positions embodying the laws of reaction of the cerebro-spinal and sympathetic nervous centres or ganglions, are, indeed, comparatively few and simple; for though the phenomena of animal life, like those of inanimate nature, are numerous, complex, and multiform, yet the laws of reaction from which they arise are not so. What, for instance, so simple as the law of gravity? yet what so complicated as the trajectories of the planets which it rules; and what requires so much profound intellectual labour as, from the laws of gravity, by the prophecy of true science, to trace such trajectories out?

In like manner, though the laws of reaction of the sympathetic and cerebro-spinal ganglions will be found comparatively simple, yet the host of anomalous morbid phenomena, which they sometimes determine, is sufficient to baffle the science even of the most skilful physician.

Some, perhaps, may ask me to shew them, with the knife and the lens, those ganglionic fibrillæ, and those muscular fibres of capillary vessels, so much talked of: and, if I cannot do this, they will deem all my finely-spun theory as impalpable to the sense of true logic as the invisible materials from which it is drawn. They may as well ask the chemist for a demonstration of his atoms by the solar microscope. Each assumption is made, only for the purpose of combining a number of phenomena under a single principle. If it had no principles but what could be physically and inductively demonstrated, the art of medicine would be much more empirical than it is.

In the works upon medicine, the abundance of phenomena is as great as the paucity of principles. Any attempt, therefore, to show how the former of these can be predicted from the latter, must, I should think, be well received by the medical public. The present is merely the introduction to a work of much greater magnitude, upon the pathology of the cerebro-spinal and sympathetic nervous systems, wherein the phenomena of various diseases will be attempted to be scientifically explained. The success of this pathological essay I am willing to rest upon the therapeutical measures which it shall indicate. Should these fail, then the reasonings by which they have been deduced must be erroneous. It was the experience of *Rassori* that overthrew the system of *Brown*, because that system was founded

on error; and every one so founded will meet its destruction from the same enemy of every thing but truth. One great and prevailing error in the systems of medical theory, however, I shall endeavour to avoid,—that is, the extension of a position to more phenomena than it truly comprehends. I thus shall be allowed to have escaped in part the censure of Gaubius. “*In eo maxime peccari,*” says he, “*quod certis incerta misceantur, et quæ nonnullis modo morborum generibus competunt, ultra, quam par est, extendi ceterisque omnibus perperam accommodari.*”

1. THE urgent necessity of studying the laws of reaction of the cerebro-spinal system of nerves, then, being granted, the first subject of inquiry is the method of induction of its phenomena. Now, we shall be considerably guided in this matter, by attending to the mode of induction pursued in the establishment of other sciences. The phenomena of the cerebro-spinal system are really the results of a set of actions and reactions. The scientific induction of these phenomena must, therefore, be founded, like that of others, upon a consideration of what are the impressing agents, and what is the mode in which these give rise to the several phenomena; that is, what changes take place in the organised tissue of the cerebro-spinal apparatus, intermediate between the impressions and the production of the effects. But before deciding upon the impressing agents which give rise to the cerebro-spinal phenomena, it may not be improper to offer some observations on the characteristic between animal and vegetable life.

2. From various observations on their progressive formation, it appears that animals and plants are formed by an extension of their blood-vessels. Such an infinite extent of wisdom, however, in the adaptation of means to ends, is discovered in this process, that it must be attributed to a power and an intelligence nothing less than Almighty. The power and the intelligence, then, by which animals and plants are formed and nourished, may be said to be those of the Intellectual Agent common to animal and vegetable life. This is the Almighty God of the universe, whose Spirit pervades all matter; in whom, and by whom, every thing of life lives, and moves, and has its being. From the very first moment of conception of an embryo man, as well as of an embryo mustard seed, this infinitely powerful and almighty Agent, either mediately or immediately, is constantly at work. It is he who forms us, as well as the mustard seed, within the womb. He creates the blood of the embryo-man, as well as of the embryo-plant. He fabricates their blood-vessels, with their nervous apparatuses; he extends these vessels, and distributes them in organs according to the various functions of these;—till the animal and plant are ready to enter upon an independent or isolated life:—independent of or isolated from their parent, but not of or from their original Creator, by whose power, and by whose intelligence, always acting according to uniform laws or modes, they are constantly nourished during the whole course of their lives. It is absurd to say that one part of an animal or plant can form another part. Can the thing created do the work of its Almighty Creator? Is there Intelligence in the blood? Do the blood-vessels, with their nervous filaments, understand the functions of the organs they are about to form by their ex-

tension, before these enter upon their exercise? Has the function of one portion of the cerebro-spinal apparatus any part in the formation of another portion of it? Certainly not. The parts are separately formed, either simultaneously, or one after another, as it may happen from the extension of the blood-vessels; and they are put together, as it may be said, before the whole apparatus is required to effect the purpose for which it was contrived. Notwithstanding the veneration entertained for his invaluable researches, it is equally painful and amusing to witness the pertinacity with which the learned Professor Tiedemann adheres to the dogma, that one part of the encephalon is formed from another part. As well might it be said that the moving beam of a steam-engine was formed by the piston, because this had been made and put in its place first, as that the grey tissue of the convolutions of the brain had any hand in the construction of the medullary filaments which lead away from it, or that these could not be formed independently of that. The different parts of the organised machine are fashioned with the intention of being put together to compose a whole apparatus, fitted for the work it has to perform in the nervous economy. M. Serres has very clearly shown, that the priority of formation of any portion of encephalon, is entirely owing to that of the developement of its arteries. Some may attribute organised structure to what are called the laws of formation. They seem to forget that a law is only the mode of acting of a power. The very constancy in the mode or law, according to which the Agent acts in the formation of animals and plants, is a convincing argument of the perfection of its intelligence. The organs were created of that nature at first, that was best adapted to their

functions; therefore there has been no occasion to alter their formation, or the mode in which these functions are performed. A piece of machinery of human invention is constantly undergoing alterations and improvements in its construction, and the mode in which it produces its effects; but the cerebro-spinal apparatus was the invention of the perfect intelligence of the Almighty, and therefore required no change: and when it does become unfit for its work, it is from the operation of spiritual and material impressions, over which the same great Being has the most perfect control.

3. But though animals and plants have much in common, yet there is something entirely peculiar to the former, which here requires to be noticed. The whole of the phenomena of animal and vegetable life primarily arise from material impressions. Without these, all the phenomena of perception, thought, and loco-motion could not exist; for there would be no consciousness in individuals of their own bodies, or of the matter which surrounds them. Without impressing elements external to them, also, neither animals nor plants could be nourished. Who could think, without previous material impressions being recorded by the soul? Who could move his limb, unconscious of the existence of his own body? The waking consciousness of the existence of the world without, or the sleeping consciousness of those impressions of the spirit which give rise to dreams, would be equally wanting. There would be neither a material object, nor the recorded idea or image of it, upon which the mind could act. Even although the body were nourished, there would be utter unconsciousness of the impressions of spirit or of matter, — a state of the most perfect coma. It is not contended, how-

ever, that, under such circumstances, the Almighty Spirit of the universe could not communicate a consciousness similar to that which is the result of material impressions. On the contrary, it is shewn that he might; for the very organs are pointed out for this effect, whereby a coloured image might be presented to the fancy, in the same way that the impression of the rays of light upon the retina, from an actual object, gives rise to the consciousness of its picture.

4. But material impressions having once been made upon animals and vegetables, the great characteristic of the former is this: the animal, by a reflected impression from its perceptive apparatus upon something within itself, becomes conscious of the external originally impressing object; and that something, again, by an impression of its own, can renew the former consciousness, and produce the phenomena of memory and fancy. This internal agent in animals can also, by its own spontaneous impressions, produce muscular contractions, and consequent voluntary loco-motion, without any immediately previous material impression. The vegetable, on the contrary, so far as we know, is not conscious of the material impression; neither can it spontaneously, by the impression of any agent within itself, renew the reaction arising from any past material impression, so as to cause memory, fancy, or loco-motion. The phenomena arising from the reaction of the nervous centres of plants, take place almost instantaneously upon the material impression, and the same reaction cannot be renewed without a fresh one. As far as we can judge from the manifestations of its own body—and that is the only foundation of judgment—there is nothing in the plant that can be made conscious, nor any ner-

vous apparatus for communicating consciousness, or for producing spontaneous muscular contractions from the impressions of an internal agent. The motions of the plant are precisely analogous to those of the alimentary canal, from the impressions of the alimentary mass. The former are determined, like the latter, by the locality of the material impression, and by this alone. No organs analogous to the grey tissue of the optic thalamus and corpus striatum are to be found in the sensitive plant. If there be an anima in plants, there is no apparatus by which it can manifest its existence to surrounding percipient beings. In regard to their want of organs for consciousness and seemingly spontaneous motions of their members, vegetables are precisely in the predicament of those monstrous fœtuses we read of, which arrive at full maturity without a brain, a spinal cord, and almost even a cerebro-spinal nerve. The mother, in this case, performs the same office to her vegetably living offspring, that the soil and the air do to the plant: the root of the organised parasite being the spongy placenta, imbibing aërated blood from the arteries of the uterus.

5. But notwithstanding that plants are unconscious of the exercise of any of their own functions, they sometimes manifest, in regard to a provision for their own wants, the operation of remarkable intelligence,—which cannot always be accounted for from material impressions. But by whatever name such manifestations may be called, there is every reason to believe that there is nothing in a plant conscious of such intelligence, nor any apparatus for communicating consciousness. In regard, indeed, to the want of consciousness of those formative processes, for the restoration or repair of lost or injured tissue, plants are not

peculiar. The higher and lower orders of animals are equally unconscious of the power and the intelligence displayed in such operations. On the contrary, the extent of these seems to be inversely proportionate to the degree of intelligence of which animals are conscious. This is perfectly in accordance with a general law of organised life:—that if the function of one organ be called into active exercise by a special impression, the functional powers of other organs will be proportionally impaired. The reparative power of the sympathetic system of nerves will be diminished, from its secretive powers being so often and so strenuously called into action from those impressions of the spirit of man and the anima of the lower animals, which give rise to the phenomena of thought and loco-motion, and from those impressions of matter which are subservient to perceptive consciousness of the external world. The *vis medicatrix naturæ* bears no proportion to the intelligence of which men and the lower animals are conscious. Let such a power never once be named by the medical philosopher; but rather let him endeavour to ascertain the modes or laws of reaction of the nervous centres: for in many instances we shall find, when a restorative operation has been attributed to an intelligent and special design for the precise occasion, it has proved only a single example of a mode of reaction of the nervous ganglions under the circumstances in which the injured tissue was placed, and which could be sufficiently explained by the operation of physical causes.

6. It is this thing, then, that is conscious, which may be called in man the spirit, or soul, or mind, and in brutes the anima. But it must be clearly understood, as essentially necessary to a full understanding of the anatomy, physiology, and pathology of the

cerebro-spinal system of nerves, that there is in man and the lower animals an intellectual agent which produces, by its special impressions upon certain organs in the vegetably living organised cerebro-spinal apparatus, the phenomena of thought and of voluntary muscular contraction. The intelligence, however, by which these impressions are selectively made, is infinitely greater than that of which either man or animals, at least in their compound capacity, are conscious. "What man," says the Apostle of the Gentiles, "knoweth the things of a man, save the spirit of man which is in him?" There are organs of impression in the brain physiologically shut in from all impressions of matter, save that of the blood which circulates in their capillaries; and it will be shewn that these organs have appurtenances analogous to those of the retina, and other similar parts of the perceptive apparatuses. Now it is evident that the blood itself cannot make selective impressions; these must be made by an intellectual agent residing in the blood,—a conclusion in accordance with a revealed position of the Old Testament, that the life of animals is in that vital fluid.

7. But consciousness of impressions from spirit and from matter, and voluntary muscular contractions, are not the only effects, in the production of which the cerebro-spinal apparatus is instrumental. Many material impressions upon it are subservient to assimilation, nutrition, and depuration. Whatever difference of character, however, obtains between the different effects produced by impressions of spirit and those of matter upon that apparatus, it is remarkable that all these effects take place in a similar manner, according to a general law. It must be carefully remembered, though, that no function in the human

economy can be carried on by the instrumentality of the cerebro-spinal ganglions alone. The sympathetic ganglions are as essentially necessary to the production of every phenomenon as the other, and even more so.

8. The next great question is, how and where are those impressions of spirit and of matter made, which are subservient to the production of the cerebro-spinal phenomena? As far as regards the latter impressing agent, under its various modifications, the question is not difficult to answer. But how shall we assure ourselves of the organ or organs, by means of which man becomes conscious of the impressions of his own spirit and of those of matter, and by which the former produce voluntary muscular contraction. It seems difficult indeed, at first sight, to assign the place of action of an impalpable agent, or the organs where itself is impressed by the cerebro-spinal apparatus or the secretion of its tissue. But it may be hoped that we shall derive great assistance in our researches from those beautiful analogies, and that simplicity of design, which are ever found to pervade the works of the Almighty. From the organised nature, the locality, and the appurtenances of the organs of impression of matter, which are known, let us endeavour, by analogy, to arrive at those of spirit, which are unknown. The sympathetic system of nerves is the simpler of the two. By contemplating the mode in which this system is instrumental in performing the functions of nutrition and of circulation in anencephalous fetuses, we may possibly arrive at some general position, which may unfold to us the secret of studying the mode in which the phenomena of the more complicated cerebro-spinal system are effected. Now, the mode in which effects are ope-

rated through the instrumentality of the sympathetic ganglions, is this: the impression is carried to a ganglion by one set of grey filaments, and an aura is returned from the nervous centre by another set of white medullary filaments to the organ, from the blood in the capillaries of which the secreted product is eliminated. We have here, therefore, the important position established, that a nervous ganglion is essentially instrumental in the function of an organ,—that to a nervous centre the influence from an impression must pass, and that from thence again an aura must be transmitted to the organ to produce its functional effect. This position may be applied with the greatest advantage in the induction of the cerebro-spinal phenomena. These, in the same manner as those of the anencephalous fœtuses or vegetables, will be found to arise from impressions carried to ganglions, and an aura transmitted from thence to organs.

9. But before specially entering upon the induction of the cerebro-spinal phenomena, with the view of ascertaining how and where the impressions subservient to the production of these are made, and how they are effected, it may greatly contribute towards a luminous view of the cerebro-spinal apparatus, if some great and fundamental positions be primarily laid down, which concern all these impressions, and the general mode in which, through the instrumentality of the cerebro-spinal and sympathetic ganglions, they give rise to phenomena. It greatly facilitates the study of any science, to have the propositions which embody its principles enunciated before they are proved. Even when purely Baconian induction is aimed at, this method is attended with signal advantages. The laws or principles of the science may be laid down in a series of distinct and success-

ive propositions, gradually becoming more special in their character, even although the inductive proof of them, according to the Baconian method of philosophising, follow after,—by remounting from the proof of the most special, up to that of the most general and comprehensive proposition. Indeed, it amounts to the same thing in the end, as to the extent of the truths absolutely communicated, whether the phenomena be first stated, and then the positions conclusively deduced from them, or these latter be stated first, and then demonstrated as truly as possible from the phenomena. Only, in the latter way, the mind is not so much distracted, by the multiplicity of details, from the comprehensive contemplation of the relations the positions have to each other. The Baconian may be deemed the better—indeed the only method for discovering the principles of a science, but that here proposed for announcing those principles must be preferred. It is absurd, of course, to apply the epithets analytical and synthetical respectively to the former and the latter of these methods. These terms should be confined to the solution of geometrical and algebraical problems, by a process bearing no analogy to the research of the laws of natural science. I shall, therefore, in laying down the fundamental and comprehensive propositions concerning the cerebro-spinal apparatus, adhere to a method somewhat novel, reversing the order of Euclid, and delivering the most comprehensive propositions first, instead of last, and gradually descending to the more simple,—throwing out occasionally, however, illustrations and proofs as we proceed. This is a method of exhibiting the anatomy and physiology of the brain, which I have adopted from several considerations:—partly from being limited as to space in publishing the discoveries

of an unknown author ; partly from the great seeming complexity of the subject ; and partly that I might secure to myself the discovery of the various scientific positions here laid down, — reserving the more extended illustration and proof of these for another larger work.

10. The first grand and fundamental position, then, as to the mode in which the cerebro-spinal phenomena are effected by the impressions of spirit and of matter, is, that these phenomena take place from the influence arising from such impressions being carried to two pairs of symmetrically situated ganglions, or primary cerebro-spinal nervous centres, and the influence again transmitted from these to organs. It will naturally be asked—What is meant by a cerebro-spinal ganglion ? And, as a satisfactory answer to this question is absolutely necessary towards a due understanding of the mode in which the cerebro-spinal phenomena are effected, it will be proper, before proceeding a step farther, to afford as clear, and, at the same time, as summary a view as possible of the nature of a ganglion, whether of the sympathetic or cerebro-spinal system of nerves. A ganglion, or primary nervous centre, then, may be defined to be a centre, to which impressions are ultimately carried by one set of filaments, while from it, again, primarily originate those filaments, along which the nervous aura passes, by which, either wholly or in part, the functions of organs are carried on. This definition applies equally to both systems of nerves, the cerebro-spinal as well as the sympathetic. In the latter, the primary ganglions are very numerous ; in the former there are only four — two symmetrically situated on each side—viz. the corpora olivaria and corpora dentata. To one or both of these primary

ganglions on either side, is carried the influence or aura secreted on every impression of the spirit or of matter upon the grey tissue at the distal extremities of a certain set of nervous filaments ; and from one or both of these ganglions, again, those filaments primarily originate, which, by the influence they conduct from these centres, are partly instrumental in effecting the cerebro-spinal phenomena in the several organs. These corpora are as peculiar in their appearance, as they are in their functions, there being no other organs in the cerebro-spinal system to which they can be at all compared. The reader will see an account of them in the *Anatomie Descriptive* of M. Cloquet, which I have not space here to quote. These two pairs of symmetrically situated ganglions are justly entitled to the name of primary ganglions of the cerebro-spinal system, seeing that the aura generated by the impressions of spirit and of matter is carried no further than them, and that it is from them also that those filaments originally arise, along which an aura or influence is conducted to the capillaries of organs either directly or through sympathetic ganglions. These cerebro-spinal ganglions are also well entitled to the designation of primary, seeing that to them the medullary filaments converge, which convey the aura or nervous influence from the grey tissue of the convolutions of the brain and of the laminæ of the cerebellum ; also because, when isolated from these nervous centres, no combination or plexus of cerebro-spinal filaments can perform its functions.

11. It being considered as established, then, till proved by special induction, that the two corpora olivaria, and the two corpora dentata, are the primary ganglions of the cerebro-spinal system of nerves, it will greatly conduce to a clear and precise

enunciation of the general positions of this system, if the nervous filaments which carry the aura or influence to these ganglions, as well as those which convey it away from them, receive appropriate designations. With this view, it is proposed to divide all the nervous filaments in the body into two great classes, the sympathetic and the cerebro-spinal. Each of these two classes, again, may be divided into two orders. Accordingly, the filaments which carry influence to the ganglions, whether sympathetic or cerebro-spinal, may be called versal filaments, while those which carry influence from the ganglions may be called déal filaments:—from the French words *vers*, towards, and *de*, from. Such designations are short and elegant, involving no hypothesis, but only expressing a fact of which there is not the smallest doubt. The two orders of sympathetic filaments may be called sympa-versal and sympa-déal, by way of distinguishing them from the corresponding orders of the cerebro-spinal system, which may be called cerebro-versal and cerebro-déal. Each of these two orders of the cerebro-spinal class, again, may be divided into two different genera, according to the names of the primary cerebro-spinal ganglions on each side with which they are connected. Accordingly, the cerebro-versal filaments may be divided into oli-versal and mori-versal; the cerebro-déal filaments into oli-déal and mori-déal, as they respectively conduct influence to or from the corpora olivaria and corpora dentata—the olivary and moriform ganglions, as they will henceforward be called. But as, in the sympathetic system, the ganglions cannot be distinguished from each other by any peculiarity in their functions, and since they are very numerous, it would be exceedingly cumbersome, useless, and inconvenient to subdivide

the two orders of sympa-versal and sympa-déal filaments into as many different genera as there are sympathetic ganglions. It is evident, also, that it would be futile to subdivide the two different genera of oli-versal and mori-versal filaments according to the variety of stimulants physiologically impressing the grey tissue at their distal extremities. That variety is so great, that the terms appropriate to it would too much cumber the nomenclature of the nervous system. The cerebro-versal filaments, however, may, notwithstanding, be divided into anima-versal and materia-versal; and the cerebro-déal filaments into anima-déal and materia-déal, respectively as they convey influence originally generated by impressions of spirit or of matter. Again, with respect to the oli-déal and mori-déal filaments, they need be divided into species, not according to the variety of functions of the organs, in the capillaries of which they terminate, but simply into cerebro-muscular and cerebro-secretory, according as they are instrumental in eliminating glandular products from the blood, or in contracting muscular fibres. The sympa-déal filaments may, in like manner, be divided into sympa-muscular and sympa-secretory. The following table contains a synopsis of this classification :—

CLASSES.	ORDERS.	GENERA.	SPECIES.
Cerebro-spinal.	Cerebro-versal.	{ Oli-versal. Mori-versal.	
	Cerebro-déal.	{ Oli-déal. Mori-déal.	{ Cerebro-muscular. Cerebro-secretory.
Sympa-thetic.	Sympa-versal.		
	Sympa-déal.		{ Sympa-muscular. Sympa-secretory.

12. Having now given a definition of the cerebro-spinal primary ganglions, and a classification of their filaments, we shall be able more precisely to lay down our fundamental and very comprehensive propositions. Some, perhaps, may be disposed to censure the introduction of so many new terms into the nomenclature of the nervous systems. Upon mature reflection, however, they will discover that such terms are absolutely necessary in explaining the mode in which the phenomena of these systems are produced by the impressions of spirit and of matter. If it were not invidious, it would be easy to adduce many expressions made use of even by the most eminent physiologists, which, strictly and scientifically speaking, are nothing but the most arrant nonsense, for want of a proper nomenclature.

13. In laying down the grand and fundamental propositions of the cerebro-spinal phenomena, it is proposed to divide these latter into those of consciousness and unconsciousness, physiologically speaking. To the former of these classes belong the phenomena produced by the impressions of spirit and of matter, and designated of perception, thought, and voluntary muscular contraction,—comprehending smell, sight, hearing, taste, and touch; memory, fancy, loco-motion, and voice. To the latter of these classes belong the phenomena of assimilation, nutrition, and depuration. But, before laying down the propositions which concern these classes in particular, it may not be improper to offer some very general observations, as to the modes in which the phenomena of both classes are operated through the instrumentality of the two pairs of symmetrically situated ganglions above-mentioned,—also to notice the functions peculiar to each symmetrical pair, as well as those which are common to both.

14. The whole cerebro-spinal apparatus, throughout all its ramifications, may be regarded as one organized body, made up of two different tissues; the one grey, for secreting a nervous aura or influence from the blood; the other white, medullary, and filamentous, for conducting that same aura from one part of the apparatus to another.* All the grey tissue which covers the convolutions of the cerebrum and the laminæ of the cerebellum, as well as the influence which that tissue secretes, being subservient to the functions in general, respectively of the olivary and moriform ganglions, may properly be termed unspecial. The white medullary filaments, again, which conduct the unspecial influence from the grey tissue of the convolutions of the cerebrum and of the laminæ of the cerebellum, respectively to the olivary and moriform ganglions, may be called unspecial versal filaments: those leading from the grey tissue of the convolutions of the cerebrum to the olivary ganglions being called unspecial oliversal filaments; those from the grey tissue of the laminæ of the cerebellum to the moriform ganglions, unspecial mori-versal filaments. This portion of the grey tissue of the cerebro-spinal apparatus is distinguished from that which is special, in physiologically receiving no impressions either from spirit or from matter, but only from the blood. The unspecial versal filaments, which take their origin in this grey tissue, are simply conductors of its glandular secretion away to its destination. They uniformly, one and all, convey the secreted aura from the glandular organization in question, but carry no influence towards it. Their physiology must be analogically inducted from

* Anat. Descript. par I. Hippol. Cloquet, Paris 1816, p. 543.

the law of the conduits of glands, according to which the secreted product is conducted away from the glandular tissue. All that grey tissue in the cerebro-spinal apparatus, again, which, physiologically, is destined to receive impressions from spirit, and from matter that either is or ought to be foreign to the red blood of man, considered simply as a fluid for nourishing the body, may, on the contrary, be called special,—the influence secreted from the blood in its capillaries being subservient to particular or special functions of the olivary and moriform ganglions. Such is the grey tissue destined to receive the material impressions subservient to perceptive consciousness of smell, of sight, of hearing, of taste, and of touch, respectively belonging to the Schneiderian membranes, the retinae, the auditory nerves in the labyrinths of the ears, the mucous membrane of the tongue, and the skin of the whole body. Such, also, is the grey tissue of the corpora striata and optic thalami, destined to receive the selective impressions of the spirit subservient to the production of the phenomena of fancy and memory, and also to the voluntary contraction of muscles of standing, of loco-motion, and of voice. Such, also, is the grey tissue destined to receive the material impressions which are subservient to assimilation, nutrition, and depuration, respectively belonging to the walls of the capillaries of the whole alimentary canal from the lips to the anus; to the walls of the capillaries of the pulmonary artery; to the walls of the capillaries of the salivary glands, and liver, and pancreatic glands, and kidneys, &c.; and to the walls of the whole of the rest of the capillary system of the aorta.

15. It is not meant to be contended, however, that this special portion of grey tissue of the cerebro-spinal apparatus, which

is destined to receive impressions from spirit and from matter, does not constantly secrete an influence which is generally subservient in promoting the functional powers of the ganglions to which it is transmitted. The contrary, indeed, is a great and important truth. This special portion of grey tissue, both when physiologically impressed, and when unimpressed, is constantly secreting a nervous aura, which promotes the functional powers of the ganglions to which it is sent. In fact, the functional powers of the cerebro-spinal ganglions are greatly dependent, as to their physiological or pathological conditions, on the normal or abnormal secretion of the grey tissue of the cerebro-spinal apparatus, whether special or unspecial ; of which there will be many examples furnished in this little work. The truth of the position here stated is beautifully illustrated by the familiar instance of a full inspiration being taken, and the air being retained in the lungs, when a considerable voluntary muscular effort is about to be made ; the volume of the chest is thereby enlarged, a greater quantity of the venous blood in the capillaries of the pulmonary artery is admitted into contact with the grey nervous tissue expanded on the walls of these vessels ; and thus a greater quantity of nervous influence is transmitted to the primary cerebro-spinal ganglions. Upon this principle also, in a great measure, depends the facility experienced by several individuals in lifting up another in the recumbent posture, provided that at the moment of effort all simultaneously take a full inspiration. It may also be observed, that the functions of the cerebro-spinal primary ganglions as to perceptive consciousness, are considerably augmented by a short suspension of the respiration after a full inspiration. Hence ardent study, which requires long-con-

tinued attention to material or spiritual impressions, is so injurious to the health, especially of the lungs.

16. By the universally diminished secretion of the grey tissue, both special and unspecial, the functional powers of the cerebro-spinal ganglions are greatly impaired. Of this we have a remarkably fine illustration in the common continued fever of this country; where a poisonous miasm, circulating in the blood, impedes the electro-chemical processes in the capillaries of the whole body. Hence loco-motion, which requires a considerable expenditure of nervous aura, is, in this disease, almost entirely abolished.

17. Such nervous aura is eliminated from the blood in the capillaries of the grey tissue, by means of filaments forming a nervous plexus around its arteries, and continuously extended upon its capillaries and veins. These arterial plexuses are composed of filaments, sometimes entirely derived from the sympathetic ganglions. Such is the case, for example, with the nervous plexuses of the internal carotid and vertebral arteries, whose capillaries nourish the cerebrum and cerebellum, organs shut in, in a great measure, from the vicissitudes of the external atmosphere, and a great variety of other pathological impressions. The plexus of the internal carotid artery, and its branches and capillaries and veins, is formed of filaments entirely arising from the superior sympathetic cervical ganglion;* that of the vertebral artery and its ramifications, is formed of filaments entirely derived from the inferior cervical ganglion.† It must not be imagined, however, that the circulatory and secretory functions of the capillaries of the cerebrum and cerebellum are entirely

* I. H. Cloquet Anat. Descrip. p. 688.

† Ibid. p. 695.

independent of the influence from the cerebro-spinal primary ganglions themselves. By medullary déal cords, the superior and inferior cervical sympathetic ganglions receive nervous aura, both of a physiological and a pathological character, not only from the primary cerebro-spinal ganglions, but also from their own congeners of the sympathetic system. On account of such communication, the secretive function of the grey tissue of the cerebrum and cerebellum may be physiologically augmented, or pathologically augmented, diminished, or abolished, respectively, by physiological and pathological impressions upon the distal extremities of the versal filaments of either the cerebro-spinal or sympathetic ganglions. This is an important position in physiology, in pathology, and in therapeutics, eminently deserving of the attention of every scientific physician. To such nervous endowment of their arteries it is owing that the cerebrum and cerebellum are so entirely unimpressible as to consciousness of pain from mechanical irritation, that they can be slashed and pricked and torn without any such effect. When the conjunctiva has been isolated from the ganglion of Gasser and its fasciculi, its unimpressibility as to pain is the same as that of the cerebrum and cerebellum; for that mucous membrane is nourished by the ophthalmic artery, whose nervous plexus is a continuation of that of the internal carotid. This was well illustrated in M. Serres's patient, whose right ganglion of Gasser, and the fasciculi proceeding from it, were found after death to be completely disorganized. Though the cheek retained its impressibility as to touch, the conjunctiva gave no token of the contact of a probe which was drawn across it.*

* Edinb. Med. and Surg. Journ. vol. v. p. 460.

18. The plexus of the external carotid artery, however, is of a different character. This artery is ramified upon organs not protected from the vicissitudes of the atmosphere, or other pathological impressions. Hence its plexus is composed, not only of filaments from the superior cervical ganglion, but also of cerebro-spinal filaments, which pass, independently and freely of that ganglion, from the glosso-pharyngeal and pneumo-gastric nerves, and the portio dura of the seventh pair.* The grey nervous tissue supplied by this artery and its various ramifications, is, therefore, under a predicament different from that of the cerebrum and cerebellum, as to impressibility to pain when mechanically irritated. Accordingly we are told, that, while the conjunctiva in M. Serres's patient was not impressible as to touch, the cheek was still so, even isolated as it was, in that case, from the ganglion of Gasser.

19. The great importance of the nervous plexuses of the arteries and capillaries and veins in the secretion of the grey tissue of the cerebro-spinal apparatus, has not met with the attention it merits. It appears, from the experiments of M. Brachet, that the integrity of the superior cervical ganglions is absolutely essential to the functions of the brain. "I sacrificed several dogs," says this ingenious physiologist, "to accomplish at once the removal of the two superior cervical ganglions. Either this removal was only partial; or the animals perished of hemorrhage at the very moment of the operation; or they sunk too soon for the results to be of any utility. By perseverance, however, I found the two ganglions, and removed them, almost

* I. H. Cloquet Anat. Descrip. p. 693.

without any immediate accidents, in a dog which survived five days. From the moment of the experiment he was agitated and restless; he always sought to be alone, and was no longer sensible of caresses. His eyes lost their lustre; then they became red; and the conjunctiva swollen. The dog was in an uninterrupted sleep; at last coma took place, and he sunk. His eyes were red and swollen, as in the other cases; the brain was injected as I have rarely observed it; the pia mater and the arachnoid were truly gorged with blood upon the anterior and middle lobes."* The same ingenious experimenter, on introducing a tube within the renal artery, and then dividing this vessel, and tying each cut end of it upon the tube, (thus isolating the capillaries of the kidney from the nervous centres, whose filaments are extended in a plexus upon their walls, and at the same time allowing the transmission of arterial blood to the gland,) found that only blood descended to the bladder.† Though the former experiment of M. Brachet is incomplete, inasmuch as, to have completely isolated the arteries of the encephalon within the cranium from the nervous centres, he should have also destroyed the inferior cervical ganglions which supply, with their filaments, the vertebral arteries; yet there are ample grounds to conclude, that the secretory function of every gland is essentially dependent upon the nervous plexuses which surround its arteries.

20. Of the great importance of the nervous system of the

* *Recherches Experimentales sur les Fonctions du Systeme Nerveux Ganglionaire*, par I. L. Brachet. Paris, 1830. P. 394.

† *Ibid.* p. 279.

blood-vessels, even the most modern physiologists and pathologists seem not always to be fully aware, although this system forms the proper subject of several treatises. The ingenious Bichat, whose too early loss medicine has yet to deplore, seems to have been fully aware of the consequence of this system in the functions of animal life. "I cannot too often repeat it," says he; "the constant connexion of arteries with the nervous system of the ganglions merits the attention of physiologists, because it is too general not to be dependent on some great purpose in the functions of the economy, although that purpose be unknown." Again, when speaking of the structure, properties, &c., of the nervous system of organic life: "We may be permitted to observe, in finishing this system," says he, "that there is none of them which more deserves the attention of physiologists." When we find well-informed pathologists unable to explain morbid phenomena arising from the nervous system of the aorta, and its branches, and capillaries, and veins, it is full time to vindicate the cause of minute anatomy, and its great importance in the science of disease. Some modern experimenters* upon poisons seem to regard, as a discovery arising from their observation, the fact, that the influence of a poisonous drug, confined within a blood-vessel, is momentarily transmitted along its walls. Such a result might have been anticipated from anatomical facts in elementary books in the hands of every body. Is not the aortic plexus, composed of filaments from the sympathetic lumbar

* Dr Addison and Mr Morgan on the operation of poisonous agents on the living body, quoted by Dr Christison in his *Treatise on Poisons*, Edin. 1832, p. 13.

ganglions, extended along both common iliac arteries, and all their branches, and capillaries, and veins? * Are there not versal filaments which carry influence to these sympathetic centres, as well as déal filaments which carry back influence from the same? Are there not medullary conductors between these lumbar ganglions and their adjoining congeners, as well as between these latter and the next, and so on?—Along the walls of vein, capillary, artery, in succession, like the electric fluid, must the impression or influence of the poisonous drug enclosed in the vein fly by the sympa-versal filaments to the sympathetic lumbar ganglions:—from these nervous centres again to be sent in two opposite directions:—along the remaining ganglions of the sympathetic system, and their déal filaments distributed upon the arteries; as well as along the déal filaments of the aortic plexus itself. Thus the muscular fibres of the whole arterial system are almost simultaneously contracted; the blood is extruded from the capillaries of the immediately vital organs, and instant death is the consequence,—as is finely exemplified in that of an animal struck with a dart envenomed with the woorara. Thus also does a portion of hydro-cyanic acid, confined in a vein by a ligature between it and the heart, prove instantly destructive of life. So far is the vascular system from being separate and distinct from the nervous, as it is often in medical writings said to be, that, on the contrary, the sympa-versal filaments, terminating upon the inner tunics of the arteries and capillaries and veins, are more delicately impressible than any part of the whole cerebro-spinal apparatus. They are alive to the contact of sub-

* J. H. Cloquet Anat. Descrip. p. 711.

stances in nature, of which our perceptive organs cannot distinguish even the existence. Witness the effect of marsh miasmata circulating in the blood, and causing that contraction of the muscular fibres of the arteries and capillaries which occasions the cold stage of intermittent fever.

21. Some authors, even of comparatively modern date, have doubted the existence of nervous filaments upon the arteries of the extremities. "*Quamvis in physiologia nulla res tam certa est,*" says Weber, "*in qua non aliquid incerti et dubii supersit, quod apte disputari possit; certissime tamen id negandum esse arbitror, a nervo sympathico, præ cæteris nervis vim vasorum capillarium derivari posse. Nemo enim anatomicus ramos nervi sympathici ad arterias extremitatum, musculorum alvi, pectoris, et dorsi, persequi potuit, quæ a nervis spinalibus nervos accipiunt. Nihilominus multum nostra interest, scire, num vis vasorum capillarium in universum a nervis derivanda sit nec ne.*"* But though it is difficult, with the scalpel and the lens, to trace the aortic plexus along the whole course of the arteries of the abdominal extremities, its presence, notwithstanding, has been indubitably demonstrated by a method quite as convincing. Sir Astley Cooper, in his excellent *Lectures on Surgery*, informs us, that when the aortic plexus was comprehended in his ligature round the aorta of a dog, its hind legs were completely paralysed: whereas when the artery was tied and that plexus left out, the animal ran about as before.† The nervous system of the arteries of a muscle are as essential to its contraction as the volun-

* *Anatomia Comparata Nervi Sympathici.* Lipsiæ, 1817. p. 159.

† *Lancet*, vol. ii. p. 47.

tary motor d  al filaments which conduct the influence to it from the brain. Nature sometimes offers us an experiment of her own, which is almost as corroborative of the truth of this position as the experiment of the above distinguished surgeon. "The ossification or the obliteration of arterial trunks," says Dr Martinet, "sometimes leads on to a palsy more or less complete, the true nature of which remains unknown, or may be even attributed to some disease of the encephalon; but it must be allowed, however, that sufficient means of distinction exist in the gradual manner in which the palsy is established in these cases, as well as in the suppression of the arterial pulsations in the affected limb. If to these characters, quite distinctive in themselves, the want of concomitant cerebral symptoms be added, no sort of mistake can happen." *

22. It is to be regretted that Sir Astley Cooper, in his detail of the above most important experiment, has not informed us whether the abdominal extremities of the dog were palsied as to touch also. It is probable, however, that this might not be the case. It must be considered that the muscles are organs physiologically shut in from the vicissitudes of the atmosphere, and impressions from any thing but the blood, and the nervous aura arriving by the voluntary motor d  al filaments; and, therefore, that organic nervous filaments proceeding from the sympathetic ganglions alone may be sufficient for their arteries. But the skin of the lower limbs being liable to the vicissitudes of the atmosphere and many pathological impressions, its arterial plexuses, in addition to the sympathetic filaments, may receive, near their

* *Revue Medicale*, Jan. 1824, p. 86.

terminations, a number of cerebro-spinal filaments independently and freely of the sympathetic ganglions ; and thus may be in the same predicament as the plexus of the external carotid artery which supplies the skin of the face. Therefore, supposing such to be the case, if the aortic plexus were destroyed, the skin of the abdominal extremities might possibly retain its impressibility as to touch.

23. The tonic or constant contraction of muscles very much depends upon the nature of the nervous plexuses of their arteries. The voluntary muscles of the abdominal extremities, for example, the nervous plexuses of whose arteries and capillaries are entirely composed of filaments from the sympathetic ganglions, are subject to almost complete relaxation when not impressed by nervous influence from the brain ; whereas the sphincter muscles of the mouth and anus, whose arterial plexuses are composed, partly of filaments from the sympathetic ganglions, and partly of cerebro-spinal filaments passing freely of these centres, are never relaxed, except on certain occasions when their contractions are overcome by those of other muscles.

24. The unspecial nervous influence secreted in the grey tissue of the cerebral convolutions, is subservient in general to the functions of the olivary ganglions. Some of these functions are peculiar to these ganglions ; others, common to them and the moriform ganglions. The olivary ganglions, for example, are the ultimate organs in the cerebro-spinal apparatus, to which the influence subservient to perceptive consciousness is carried, before it can take effect. Accordingly M. Flourens informs us, that when he removed the cerebellum in pigeons, these animals, still in possession of their perceptive faculties, could spontane-

ously renew their struggles even though unable to walk. "At last, when the whole cerebellum is removed, it cannot support itself even with the aid of its wings and tail; it makes violent efforts to rise, but only rolls up and down; then, fatigued with struggling, it remains for a few seconds at rest upon its back or belly, and then again commences its vain struggles to rise or walk. Yet all the while its sight and hearing are perfect,—the slightest noise, threat, or other stimulus, at once renews its contortions."* "Sensibility, whose seat some authors have placed in the cerebellum, did not appear to be specially injured," says Professor Andral, "in cases of hemorrhage of that organ."† There is an instance, of a very instructive nature, of the isolation of the cerebro-spinal apparatus from the moriform ganglions, furnished to us by M. A. L. J. Bayle, in the April No. of the *Revue Medicale* for 1824—being a case of apoplexy of the cerebellum, where the clot extended to both its hemispheres. The patient here could smell, and see, and hear, and taste, and touch; remember, and fancy; and, although his powers of thought were enfeebled, yet they were sane in effect. It is worthy of observation, that the individual in this case lived nearly the time that some animals do after the division of their pneumo-gastric nerves;—he survived the sanguineous effusion only five days. We have also a very instructive case of what may be considered an isolation of the same sort, quoted by Dr Andral from M. Lallemand, wherein the individual retained all his senses, notwithstanding the cerebellum was entirely transformed into a sac full

* Edin. Med. Journal, vol. xxi. p. 151.

† Andral Clinique Medicale, Paris 1834, vol. v. p. 689.

of pus.* Professor Andral, indeed, mentions a case of Dr Gall's, where the two lobes of the cerebellum were in a state of suppuration, and where there was blindness; but here the pons Varolii was remarkably in a state of atrophy, and of a yellow colour.† Upon the whole, then, it may be concluded that the moriform ganglions are not directly essential to the functions of perceptive consciousness.

25. With regard to the instrumentality of the moriform ganglions in voluntary muscular contraction, though it certainly appears, from some observations of the learned Professor Andral, that hemorrhage into one lobe of the cerebellum causes hemiplegia of the opposite side, yet in the case of M. Bayle just mentioned, and also in that of M. Lallemand, notwithstanding the destruction of the cerebellum, the voluntary muscular contractions could be effected. In the case of M. Bayle, the patient could put out her tongue on the slightest intimation, and could give her arm to be felt for the pulse. In the case of M. Lallemand, the individual still continued to walk about; only he staggered, and often fell forward, showing the great influence of the cerebellum in maintaining the tonic contraction of the muscles which bend back the head and spine, and extend the lower extremities—that is, of the protective muscles, as will afterwards be shewn. Such a case as this may be considered as a more perfect isolation of the cerebro-spinal apparatus from the moriform ganglions, than most cases of hemorrhage of the cerebellum. The effused blood increasing the volume of the organ in which it is shed, like a foreign mass superadded, may cause a

* Andral, *loco cit.*, p. 707.

† Ibid. p. 708.

pressure upon the contiguous parts, thus complicating and multiplying the pathological consequences, beyond what are proper to the isolation desired. Upon the whole, then, it may be concluded, that the moriform ganglions are not the primary cerebro-spinal nervous centres, to which the influence arising from selective impressions of the spirit is carried to produce muscular contractions. The justice of this conclusion is also corroborated by the artificial isolations of M. Flourens. When the whole of the cerebellum was removed in his pigeons, they could spontaneously renew their struggles, either with or without disturbance. This experimental physiologist has attributed to the moriform ganglions, and the unspecial apparatus belonging to them, the instrumentality of regulating the muscular contractions for standing and loco-motion ;* but in this conclusion he seems to be mistaken ; as we find that M. Lallemand's patient could both stand and walk, notwithstanding these ganglions were completely destroyed ; and M. Bayle's patient could move his hand to an object. It is by the impressions of the spirit, determined by its consciousness of the strains of the body upon certain muscles, that the erect position is maintained in standing and walking.

26. Now it is because the olivary ganglions are properly the organs of perceptive consciousness in the cerebro-spinal apparatus, and the primary ganglions, to which the nervous aura is sent which is subservient to the voluntary contraction of muscles, that the grey unspecial tissue with which they are furnished is comparatively so very extensive, and that we find it so much augmented by the convoluted disposition in man and the higher or-

* Edin. Med. Journal, vol. xxi. p. 151.

ders of animals in proportion to their intellectual powers. Perceptive consciousness, and the contraction of the larger muscles employed in loco-motion and voice, are functions which require a vast expenditure of nervous aura, and it is therefore requisite that the nervous ganglions appropriated to them should be endowed with such an extensive grey tissue in their unspecial apparatuses.

27. But perceptive consciousness of the impressions of matter and of spirit, giving rise to smell, sight, hearing, taste, and touch, and memory and fancy, and volition of the contraction of the larger muscles, are not the only functions of the olivary ganglions. There are two other orders of functions, in which these nervous centres are jointly instrumental alongst with the moriform ganglions. These two orders of functions are, first, the contraction of the larger muscles from the impressions of matter; secondly, the contraction of the muscular fibres of the heart, of the arteries, and of the capillaries, and the elimination of the glandular products from the blood in the latter vessels. The unspecial as well as special influence, subservient to each of these orders of functions, is transmitted equally to both the moriform and olivary ganglions on the same side; and, consequently, each of these nervous centres has a part in these two orders of functions. But should the moriform ganglions be removed by disease from the cerebro-spinal apparatus, the olivary ganglions may, perhaps, in part, for a time supply their place. This would appear to have been the case in the patients of MM. Bayle and Lallemand above-mentioned, where, by hemorrhage and suppuration, the functions of the moriform ganglions must have been destroyed. If it were asked, by what characteristic these two

orders of functions, in which the moriform and olivary ganglions are jointly instrumental, are distinguished ; it may be said that these two orders of functions are eminently protective of the organs of impression, by shutting them in, or removing them to a distance, from noxious bodies by the contraction of muscles ; and protective of the tissue of these organs, by preserving the contractile tone of the muscular fibres of the arteries, and the circulatory powers of those of the capillaries, thereby preventing the supervention of inflammation from the contact of noxious substances, and by washing away such substances by the increased secretion of protective glands. These two orders of functions may also be said to be protective, as being instrumental in assimilation, nutrition, and depuration ; and also by contributing to the tonic or constant contraction of the sphincter muscles of the mouth, the anus, and the neck of the bladder, by sending their filaments to the nervous plexuses of the arteries of those organs independently and freely of the sympathetic ganglions, as was shown in the case of the external carotid artery.

28. Accordingly it would appear, then, that the functions of the olivary ganglions may be divided into four different orders. First, those of perceptive consciousness ; secondly, those of the voluntary contractions of muscles,—which two are more peculiar to these ganglions ; thirdly, those of the involuntary contraction of the larger protective muscles from impressions of matter ; and, fourthly, those of the organic order,—which two are common to the olivary and moriform ganglions, and are called protective. The functions of the moriform ganglions, however, are only more properly of two orders, both protective—viz. those just mentioned, in which they are jointly instrumental with the olivary ganglions.

ON THE UNSPECIAL VERSAL APPARATUS OF THE OLIVARY
AND MORIFORM GANGLIONS.

29. It must, therefore, be distinctly understood, that the unspecial influence secreted in the capillaries of the grey tissue of the cerebral convolutions, is subservient to four different orders of functions of the olivary ganglions, to which that tissue properly appertains. There must, consequently, be as many different orders of filaments, to conduct such unspecial influence, when secreted, away from the same tissue to these ganglions. It is now proposed, then, to trace out the courses of these four orders of filaments. But, before doing this, it must be had in view that the special versal portions of the apparatuses of smell and sight, as well as those of fancy, memory, and voluntary muscular contraction, have, properly speaking, nothing more to do with the unspecial versal apparatuses of the olivary ganglions, than the special versal portions of the apparatuses of hearing, of taste, and of touch. Let the unspecial versal apparatuses of the olivary ganglions, then, be studied in their simplicity. Let them be divested of the olfactory and optic nerves, as well as of the grey tissue of the corpora striata and optic thalami, and the medullary filaments which lead from that tissue to the olivary ganglions. The two former cling to the brain, merely for the sake of being ultimately distributed upon the upper part of the face; the two latter, to enjoy exemption from pressure by being enclosed in the cavity of the cranium. The adherence of neither the former nor the latter to the brain is necessary to the performance of their functions.

30. "Each convolution," according to Drs Gall and Spurzheim, the ingenious anatomists of the encephalon, "is a kind of small purse or canal, closed externally by a double layer of cineritious and medullary matter, and on the side of the ventricle by the converging medullary fibres."* Notwithstanding of this, however, it is probable that the unspecial influence, secreted in every point, on each side of the surface of a cerebral convolution, is conducted to the bottom of that convolution, and passes, by means of an anastomosis of the medullary filaments there, into every one of the four different orders of filaments. What M. Cloquet has observed of the medullary tissue at the bottom of the superior convolutions, applies equally to all those of the brain: at the same time considering his diverging fibres to be truly converging. "At the bottom of the superior convolutions," says he, "the converging filaments are perceived to constitute a sort of tissue with the divergent, to unite unto filaments still larger, and to cover the roof of the lateral ventricles. It is from this tissue, then, of anastomosis, as it is presumed to be, that it is now proposed to trace the course of the unspecial influence along these different orders of filaments,—each different order conducting that portion of influence subservient to the order of functions to which it belongs.—May not the grey tissue of one side of a cerebral convolution secrete what may be called a positive nervous influence, while that of the other side of the same convolution secretes a negative influence, and the effect be produced by the anastomosis of the respective medullary con-

* Report on Gall's Anatomy of the Brain, by Tenon, Portal, Sabatier, Pinel, Cuvier. Edin. Med. Journ. vol. v.

ductors, as in the case of the meeting of the negative and positive wires of a galvanic battery ?

31. Three of these four orders of filaments together constitute the great re-entrant system of the ingenious Dr Gall. These three orders of filaments conduct from the grey tissue on every part of the convoluted surface of the brain, unspecial influence subservient—1st, to perceptive consciousness ; 2d, to the contraction of the larger muscles from the impressions of matter ; 3d, to the contraction of the muscles of the heart, arteries, and capillaries. But as the unspecial influence subservient to the two latter orders of functions may be said to be protective, so the two orders of filaments which conduct it may pass together under the same designation. Such a sameness of designation may be applied to them with the greater propriety, as their course and destination are precisely the same. In speaking of the great re-entrant system of Dr Gall for the future, then, it will be convenient to describe it as composed only of two different orders of filaments—the unspecial perceptive oli-versal filaments, conducting unspecial perceptive influence to the olivary ganglions of the opposite side, to be subservient to them in their functions of perceptive consciousness,—and the unspecial protective versal filaments, conducting unspecial protective influence to the olivary and moriform ganglions of the same side, to be subservient to them in their joint protective functions.

32. Now there are two scientific positions concerning the course and distribution of these two orders of unspecial versal filaments, which explain some lineaments in the anatomical features of the great re-entrant system in question, of which no explanation, as far as I am aware, has ever yet been offered.

All the unspecial influence secreted in the grey tissue of the convolutions of the right cerebral hemisphere subservient to perceptive consciousness, passes to the left olivary ganglion. All the unspecial perceptive oli-versal filaments, therefore, which conduct that influence from those convolutions to that ganglion, make their transit to it across the median plane of the cerebro-spinal apparatus. On the contrary, all the unspecial influence secreted in the grey tissue of the convolutions of the right cerebral hemisphere, subservient to the protective functions conjointly of the olivary and moriform ganglions, passes to these ganglions on the right side. The unspecial protective versal filaments, therefore, which conduct that influence from those convolutions to these ganglions, do not cross the median plane of the cerebro-spinal apparatus.

33. It is very remarkable, that the same positions apply respectively to the special perceptive and special protective influences, as well as to the special perceptive oli-versal and special protective versal filaments that conduct these influences. The perceptive influence, unspecial as well as special, secreted in the grey nervous tissue of the right side of the cerebro-spinal apparatus, thus passes to the left olivary ganglion: the unspecial as well as special protective influence, secreted in the grey nervous tissue of the right side of the cerebro-spinal apparatus, simultaneously passes to the right olivary and moriform ganglions. Such positions, however, must be understood as applying only to the special apparatuses of perceptive consciousness, which are symmetrically divided by the median plane of the cerebro-spinal apparatus. It is evident, that, by such an arrangement, the special impression gives rise to a secretion, not only of special,

but also of unspecial influence. The influence arising from the special impression passes to sympathetic primary ganglions, whose filaments are distributed upon the arteries of the unspecial grey tissue. The impression of the light upon the right retina, for example, being conveyed to the right superior cervical ganglion, gives rise to an increased secretion in all the grey nervous tissue supplied by the arteries and capillaries branching off from the internal carotid artery, the filaments of whose nervous plexuses are entirely derived from that sympathetic nervous centre.

34. I should next proceed to trace the two orders of filaments forming the great re-entrant system ; but, before doing so, a most important observation upon the general anatomy of this system presents itself. This great system may be divided into three minor systems, entirely independent of one another, in as much as each furnishes the medium of transition of the two orders of unspecial versal filaments, of which it is composed, to their respective destinations. These minor systems are—1st, that of the anterior commissure of the brain, with the converging filaments from the anterior inferior convolutions of the brain which contribute to form it ; 2d, that of the fornix, with its cornua ammonis, posterior pillars, body, and anterior pillars ; 3d, that of the corpus callosum, with its transverse filaments, septum lucidum and anterior pillars, combined with those of the fornix. Such independence in these three minor systems of the great re-entrant system, at least as regards the second and third, has not escaped the notice of the learned Professor Tiedemann. “ Nor have anatomists,” says he, “ been fully acquainted with the structure and manner of formation of the septum lucidum. They have, in general, considered the two plates of this septum as

parts descending from the inferior surface of the corpus callosum to the superior surface of the fornix. This idea is evidently erroneous, for the two plates rise from the anterior pillars of the fornix, and proceed upwards to gain the inferior surface of the corpus callosum, with which they unite. This is evidently proved by the direction and radiation of the medullary fibres, which always proceed from the pillars towards the corpus callosum, expanding and inclining backwards."* Of these three minor systems, that of the anterior commissure, as we descend in the scale of animal life, is the longest persistent; remaining after those of the fornix and corpus callosum have vanished. "We find," says Dr Tiedemann, "neither fornix nor septum lucidum, properly (so) called, in fishes, reptiles, or birds."†

35. It may now be known, then, that the unspecial perceptive oli-versal filaments, and the unspecial protective versal filaments, conducting unspecial influence from the convolutions of the right cerebral hemisphere, accompany each other from the places of anastomosis at the bottoms of these convolutions, to within a very short distance of the median plane of the cerebro-spinal apparatus. In the instance of the minor system of the corpus callosum, the two orders of unspecial versal filaments in question accompany each other as far as the curvilinear line on the right side of the median line of that corpus. In the instance of the fornix, another portion of those same two orders of unspe-

* The Anatomy of the Fœtal Brain, by Frederic Tiedemann, translated from the French of A. J. L. Jourdan, by W. Bennet, M. D. Edin., 1826, p. 276.

† Ibidem, p. 272; see also p. 273.

cial versal filaments accompany each other as far as its right side. In the case of the anterior commissure, the same accompaniment takes place, till where the fasciculus of the anterior commissure leaves the mass of the right hemisphere. It may here be observed, that the most beautiful analogy prevails between the unspecial and special versal apparatuses of the primary cerebro-spinal ganglions, which are subservient to perceptive consciousness. As the unspecial perceptive oli-versal filaments accompany the unspecial protective versal filaments, for a certain distance from the unspecial grey tissue of the cerebral convolutions of the same side on which they originate; so the special perceptive oli-versal filaments accompany the special protective versal filaments, for a certain distance, greater or less according to circumstances, from the special grey tissue in which they originate. This beautiful analogy assures me of the truth of the positions which it embraces. Its simple elegance will not be fully perceived till we come to treat of the special versal apparatuses of perceptive consciousness in their order.

36. Having now traced the unspecial perceptive oli-versal, and the unspecial protective versal, filaments to the proximal points of their lines of association, it next remains to trace them to their several destinations from these points. In the case of the corpus callosum, the unspecial perceptive oli-versal filaments from the superior and anterior convolutions of the right cerebral hemisphere, having left the curvilinear line on the right side of the median line of that corpus, pass to this latter line, which they traverse, and so gain the left lamina of the septum lucidum. Down this septum, converging, they reach the left anterior pillar of the fornix. From this, again, they proceed to

the left corpus mamillare ; from the left corpus mamillare they pass along the inner edge of the left crus cerebri, through below the transverse filaments of the left side of the pons Varolii, and so on till they gain the left olivary ganglion. In the instance of the fornix, the unspecial perceptive oli-versal filaments from the posterior and inferior convolutions of the right cerebral hemisphere, begin to leave the unspecial protective versal filaments, even before the right join the left posterior pillar of the fornix. Such perceptive oli-versal filaments, crossing the median plane of the cerebro-spinal apparatus, as it may be said thus prematurely, constitute the right half of those filaments which have received from anatomists the name of the lyre. This, altogether, is formed, in this way, of the right and left unspecial perceptive oli-versal filaments seeking, respectively, the left and right anterior pillars of the fornix along its left and right edges. The perceptive oli-versal filaments, then, proceeding from the right cerebral convolutions, having left the protective versal filaments at the right side of the fornix, cross the median plane of this body to gain its left side ; along which they proceed to the left anterior pillar of the fornix. Thus the unspecial perceptive oli-versal filaments, conducting influence from the right cerebral convolutions, along the right cornu ammonis, and the right posterior pillar of the fornix, in one continued medullary fasciculus, pass to the left anterior pillar of that minor re-entrant system. From thence, again, along with the perceptive oli-versal filaments of the minor system of the corpus callosum from the right hemisphere, by the course already pointed out, they gain the left olivary ganglion. Lastly, in the case of the minor but independent system of the anterior commissure, the unspecial

perceptive oli-versal filaments conducting unspecial influence “from the anterior convolutions of the middle lobes, and from some of those near the fissure of Sylvius” * of the right hemisphere, leaving the protective versal filaments at the place before-mentioned, where the fasciculus of the anterior commissure is disengaged on the right side from the encephalic mass, traverse the median plane of that fasciculus, and so gain the left crus cerebri, along which, in company with the unspecial perceptive oli-versal filaments of the two other minor re-entrant systems already described, and by the same course, they gain the left olivary ganglion. In this manner, then, the unspecial perceptive portions of the three minor divisions of the great re-entrant system, which conduct unspecial influence from the grey tissue of the convolutions of one hemisphere, convey it to the olivary ganglion of the opposite side, to be unspecially subservient to it in its functions of perceptive consciousness.

37. In support of the transition of the perceptive oli-versal filaments from the curvilinear line on the right side of the median line of the corpus callosum, across this latter line, and down the left lamina of the septum lucidum, I have to adduce the authority of M. Laurencet, from a memoir by him, in the Nov. No. of the *Revue Medicale* for 1824, upon a new method of exposing the anatomy of the brain. With the views of this ingenious author on the brain, I have at present nothing to do. Only it is necessary here to state, that the laminæ of the septum lucidum are what he means by the internal membranes. “The two internal membranes,” says he, “rise vertically, and place them-

* Tiedemann, *loco cit.*, p. 222.

selves back to back, to form the double transparent septum which fixes itself to the corpus callosum ; so that the fibres of the right lamina are connected with those of the corpus callosum belonging to the left hemisphere ; and vice versa, those of the left lamina with the fibres of the corpus callosum which proceed from the right hemisphere." Describing the corpus callosum—"Along the middle of its surface," says Winslow, "there is a kind of raphe, formed by a particular intertexture of fibres which cross each other ; for though these fibres appear to be transverse, yet they are really a little oblique, and those that come from the right side, intersect those that come from the left. This raphe is made more perceivable by two small medullary cords which accompany it on each side, and adhere closely to the transverse fibres." As for the connexion of the left anterior pillar of the fornix with the left corpus mamillare, it is so commonly known as not to require any proof. But though it may not be so commonly known, yet it is no less certain, that a fasciculus of medullary filaments passes from the surface of the left corpus mamillare to the left olivary ganglion, along the inner edge of the left crus cerebri, through below the transverse filaments of the left side of the pons Varolii. "The mamillary eminences," says Dr John Gordon, "are formed of greyish brown matter, surrounded completely by a layer, about a twentieth of an inch thick, of orange-white matter. It is to this white layer, that the prolongations from the anterior pillars of the fornix already described, are attached. It sends off also from its upper surface, a cord about a sixth of an inch in diameter, which runs upwards and outwards into the thalamus opticus for the length of half an inch, describing first a curve forwards and then back-

wards, and gradually tapering to a point. The outer stratum of the eminences is continued behind, into the white matter of the peduncles of the brain proper." * Now, that there really is also a connexion between the medullary fasciculus, passing along the inner edge of the left crus cerebri, through below the transverse filaments of the left side of the pons Varolii, close to the median septum of this—and the left olivary ganglion, we may gather from the description of the medulla oblongata by the same excellently precise writer. "The top of the cord," says the too early lost Dr John Gordon, "contains, on each side, between the median plane, and the oblong and oval eminences, a substance exactly similar to the corpus dentatum in the cerebellum, and to which the same name may be applied. It is oval-shaped and flattened. Its long diameter lies upwards and downwards; and its flattened surfaces are turned, one forwards and inwards, the other backwards and outwards. It is about five-eighths of an inch long, a quarter of an inch broad, and a sixth of an inch in thickness. Its outer half occupies the whole length of the oval eminence; and its capsule is separated from the surface of this eminence only by a stratum of orange-white matter, about a twentieth of an inch thick. Its inner border reaches to within a fifteenth part of an inch of the median plane. Its capsule consists of the same brown matter as that of the corpus dentatum in the cerebellum; but its indentations are finer. This capsule is generally quite complete along the outer half of the body; but towards the inner border I have always found several small de-

* A System of Human Anatomy, by John Gordon, M.D. Edin. vol i. p. 131: see also p. 129.

ficiencies in it.”* I propose to contend, then, that in the places where such deficiencies occur in its capsule, the versal filaments enter the left olivary ganglion. Such is precisely the case with the corpora dentata, or moriform ganglions, as, for the sake of nomenclature, we have called them. Describing the corpus dentatum—“On the fore part where it rests, as it were, on the roof of the central fissure of the cerebellum,” says Dr Gordon, “the lower part of its capsule seems wanting altogether; so that at this point, the white matter forming its nucleus, is connected directly with the white matter belonging to the pillar of the Vieussenian valve on the same side.”†

38. It is interesting to contemplate the morbid states, as to quantity and quality, of the unspecial influence subservient to the perceptive functions of the olivary ganglions. The secretion of this influence in the capillaries of the grey tissue of the cerebral convolutions may be temporarily diminished, like that of any other glandular product. Such a state may arise, either from a deficient quantity of blood in these capillaries, or a morbid state of the superior cervical ganglion, whose filaments supply the nervous plexus of the internal carotid artery; or from a total abolition of the functional power of that glandular tissue from inflammation, as in the latter stage of meningitis. Accordingly Dr Martinet informs us, in conformity to the general position (33) of the unspecial and special influence passing to the opposite olivary ganglion, that, in encephalitis, “the sensibility of the affected” side is “totally lost.”‡ The unspecial is essentially

* Dr Gordon, *loco cit.*, p. 184.

† Ibidem, p. 144.

‡ Manual of Pathology, by L. Martinet, D.M.P., translated by Jones Quain. London, 1829, p. 133.

necessary to the effect of the special influence. When the former is abolished, the latter can no longer give rise to perceptive consciousness. In fact, as will be afterwards shewn, the special perceptive versal filaments must combine with the unspecial perceptive versal filaments before these reach their respective olivary ganglions.

39. But the unspecial influence, subservient to the olivary ganglions in their functions of perceptive consciousness, after having been physiologically secreted, may be impeded in its progress to its ultimate destination. This may happen from pressure upon, or destruction or inflammation of, the unspecial perceptive medullary tissue in some part or other between the cerebral convolutions and the olivary ganglions. The consequence of such an impediment is an utter abolition of all perceptive consciousness, whether of the impressions of spirit or of matter—a state of the most perfect coma; wherein the individual can neither remember nor fancy,—nor smell, nor see, nor hear, nor taste, nor touch; though, immediately before the supervention of the comatose state, he could voluntarily contract the muscles of his limbs, and speak. Such a pathological state is found to supervene, even on the destruction of two out of three of the divisions of the re-entrant system—viz. those of the corpus callosum and fornix. “When there is no paralysis or muscular rigidity at either side of the body,” says Dr Martinet, “and when a comatose state occurs, and goes on progressively increasing, we may suspect inflammation of the corpus callosum, septum lucidum, or fornix.”* The same author, also, in the Jan.

* Dr Martinet's Manual of Pathology, p. 133.

No. of the *Revue Medicale* for 1824, gives a case, where, after death, the corpus callosum was softened to the consistence of soft cheese, and the vault with three pillars was reduced to a diffuent pulp. The patient at last sunk in a state of the most perfect coma ; but there was no palsy as to muscular contraction. The individual, as long as he was conscious, could execute voluntary muscular movements of all his limbs. In one day's report are the following observations :—" The 14th, intelligence perfect ; no disturbance of the motor system of the limbs and the face ; sensibility natural in all parts of the body ; only a propensity to sleep as soon as he is no longer spoken to, and very manifest moral lethargy." There is an instance of congenital deprivation of the corpus callosum, quoted by Dr Tiedemann from Reil, attended by idiocy, where that body presented a solution of continuity in the whole length of its middle line. The power of contemplating or perceiving fancied or remembered ideas, depends as essentially on the due transmission of the unspecial perceptive nervous influence to the olivary ganglions, as upon the quantity of it secreted in the unspecial grey nervous tissue on the surface of the cerebral convolutions. A portion of that influence was intercepted, in the brain of the poor woman, to its proper destination, and forced, from the place of anastomosis at the bottom of the convolutions, into a different course along the order of unspecial olivary motor filaments, which remain the last in order to be described.

40. That the unspecial influence subservient to perceptive consciousness passes to the olivary ganglions, by medullary filaments, in the course already pointed out, along the inner edges of the crura cerebri, receives a remarkable confirmation from

an observation of MM. Parent du Châtelet and Martinet, in their work on Arachnitis. These authors, says Professor Andral, have assigned a profoundly comatose state as a symptom specially characterising meningitis of the base of the brain.* The coma, in such cases, must arise from the conducting power of the unspecial perceptive oli-versal fasciculi at the inner edges of the crura cerebri being abolished by inflammation, or the pressure arising from its products.

41. Speaking of the experiments of Rolando—"He imagines," says M. Flourens, "that the destruction of the corpus callosum was sufficient, as Lapeyronie thought, to destroy the senses and intelligence." Rolando is right; pathological observations are completely on his side. The effects arising from the deprivations by disease are much more to be trusted, in inducing the functions of organs, than those arising from deprivations by the hands of man. When the corpus callosum, septum lucidum, and fornix, are destructively softened, without any other lesion of the brain, no further pathological condition is inflicted to complicate the results. Surely, in such case, the functions dependent upon the influence which the filaments of that disorganized tissue conduct, must be abolished. He who will not induct from these isolations, so neatly executed by spontaneous disorganization, but rather trust to his own slashing experiments, has yet to learn the art of physiological logic.

42. It is only unfortunate, that in the experiments of Rolando just alluded to, and in those of natural disease, the destruction of the great re-entrant system was not complete. From even

* Andral, *loco cit.*, p. 64.

the small amount of unspecial perceptive influence, conducted to the olivary ganglions by the unspecial perceptive oli-versal filaments, forming a portion of the converging filaments, which together constitute the minor system of the anterior commissure, the individuals, for a time, occasionally resumed their consciousness. In the pathological observations, however, the unspecial perceptive oli-versal apparatuses on both sides were partly destroyed. But if we conceive the unspecial perceptive oli-versal filaments, carrying unspecial perceptive influence from the convolutions of the right hemisphere to the left olivary ganglion, to be cut, previously to their transit across the median plane of the cerebro-spinal apparatus,—then perceptive consciousness, from the impressions of matter upon the distal organs of impression of the perceptive apparatuses on the right side of that median plane, will not follow: the right nostril, the right retina, and so on, will be unimpressible as to smell, sight, &c. On the other hand, if we conceive the unspecial perceptive oli-versal fasciculus, passing along the inner edge of the left crus cerebri—a continuation of the unspecial perceptive oli-versal filaments above-mentioned—to be divided, then the deprivation of function, in the distal organs of impression of the perceptive apparatuses, will be still on the right side of the median plane of the cerebro-spinal apparatus, while the lesion is on the left. This is a prediction of science yet to be fulfilled, as far as I am aware, by pathological experiments executed by the hand of man or by disease. Such inflictions, however, are difficult of performance by art,—Nature has guarded the organs in question so well. I have said pathological experiments—for such they are, as M. Bouillaud has very justly observed. “But if, on one hand,” says this distinguished

writer, " physiology is the true torch of pathology, it is equally certain that pathology is an inexhaustible source of elucidation for physiology. It leads us to the knowledge of the functions of organs in the most direct manner ; and let it be observed, that it is the means physiologists make use of to discover the still unknown functions of a given organ. After all, are not experiments upon animals—*vivisections*—it may be said, artificial diseases? Is not experimental physiology a sort of artificial pathology?

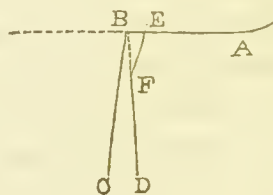
43. The influence secreted in the grey tissue of the cerebral convolutions has all along been called unspecial ; and, let phrenologists say what they will, it is so. This appears from many observations. We all have heard " the account of twenty-two French soldiers, whose vertices, with more or less of the brain, were cut off by sabre strokes. All these men ultimately died ; but, at first, had not a single bad symptom, and performed a journey of thirty leagues after being wounded, and one-half of this distance on foot."* If any portion of the grey tissue were subservient to particular functions of perceptive consciousness, certainly some of these functions would have been abolished in those cases where the greatest two out of three of the minor divisions of the great re-entrant system had their conductive function abolished. But this was not the case ; the functional powers of the perceptive apparatuses, in such cases, were only generally impaired. The results of the cerebral slicings of the lower animals also corroborate the doctrine of the unspeciality

* A Dictionary of Practical Surgery, by Samuel Cooper, London 1822, p. 573.

of the grey nervous tissue of the cerebral convolutions as regards perceptive consciousness. "It follows, from the experiments of M. Flourens, that in the gradual lesions of the cerebral lobes, as long as one sensation survived, all survived; that when one was lost, all were lost; and, consequently, that the faculty of perceiving is essentially single." *

44. Having now traced the course of the perceptive portion of the great re-entrant system of unspecial versal medullary filaments, from the points where it left the protective portion of the same, it now remains also to trace out this latter. First, in the case of the minor system of the corpus callosum and septum lucidum, with its anterior pillars, the unspecial protective versal filaments, proceeding from the convolutions of the right cerebral hemisphere, having left the others at the curvilinear line on the right of the median line of that corpus, pass obliquely downwards, to join, forming with it an acute angle opening upwards, the right lamina of the septum lucidum: converging down which they reach the right anterior pillar, as it is called, of the fornix.

45. Let a plane, passing through one of the anterior pillars of the minor system of the corpus callosum, and perpendicular to the median plane of the cerebro-spinal apparatus, cut transversely the surface of the corpus callosum in the line AEB, perpendicular to its median line; the curvilinear line on the right of that line at E; that median line itself at B; and the two laminæ of the septum lucidum in the lines



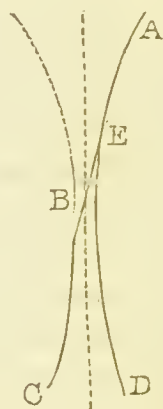
* *Revue Medicale*, Jan. 1824, p. 175.

BC and BD. Then it is evident that the line AE may, very properly, represent the fasciculus, composed of an unspecial perceptive oli-versal filament, and of an unspecial protective versal filament, conducting influence from the convolutions of the right cerebral hemisphere in the direction AE; while BC and BD may represent filaments, which converge from the median line of the corpus callosum to the anterior pillars at C and D. Now at E, the unspecial perceptive oli-versal filament, leaving the unspecial protective versal filament, with which it had been associated from the tissue of anastomosis at the bottom of the convolutions of the right hemisphere to the point E, passes to the median line of the corpus callosum at B. From this point it passes down the opposite or left lamina of the septum lucidum BC, to gain the opposite or left anterior pillar of the fornix at C. The unspecial protective versal filament, again, from the point E passes downwards, to join, at the angle EFB, it is presumed, the corresponding or right lamina of the septum lucidum BD, by which to reach the corresponding or right anterior pillar of the fornix, D; or, as it may more properly be called, the right anterior pillar of the corpus callosum and septum lucidum.—The diagram, as far as regards AE and EB at least, is nearly double of the natural dimensions; and the lines of section BC, BD, of the laminæ of the septum lucidum, are, for the sake of distinctness, drawn much farther apart than they really are. According to Dr John Gordon, EB is only about 1-24th of an inch.

46. Secondly, in the case of the fornix, the unspecial protective versal filaments, from the convolutions of the right cerebral hemisphere, having left the unspecial perceptive oli-versal filaments at the right side of the fornix, continue on that side till

they reach the right anterior pillar of this minor system. It is evident, then, that this pillar must be composed of unspecial perceptive oli-versal filaments from the left cerebral convolutions, and of unspecial protective versal filaments from the right cerebral convolutions. The former of these two sets of filaments have already been traced to the right olivary ganglion: it therefore now only remains to trace the latter, according to a scientific position already laid down (32), to the right olivary and moriform ganglions.

47. In this diagram, representing the system of the fornix, ΔE is the twofold fasciculus, composed of an unspecial perceptive oli-versal, and an unspecial protective versal filament, respectively conducting unspecial perceptive, and unspecial protective influence, in the direction ΔE . The fasciculus ΔE is, therefore, very properly representative of that medullary fasciculus constituting the cornu-ammonis and corresponding posterior pillar of the fornix of that side, as far as till the point where that pillar begins to send off the medullary filaments constituting the lyre. The unspecial perceptive oli-versal filament, leaving the other at E , reaches and traverses the median dotted line, to gain the opposite side of the fornix BC , along which it proceeds to the opposite anterior pillar of the fornix at C . The unspecial protective versal filament, again, leaving the other at E , continues on the same side of the fornix ED , and so gains by it the corresponding anterior pillar of that minor system at D .—The anterior pillars of the fornix, though perfectly distinct

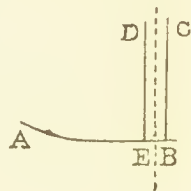


from each other, are yet in nature closely approximate. They are drawn widely separate in this diagram, only for the sake of distinct elucidation.

48. The anterior pillars of the fornix, as they are called, belong equally to the two divisions of the great re-entrant system called the corpus callosum and its septum lucidum, and the fornix. Accordingly, "the anterior pillar, being double," says Winslow, "is longer than either of the posterior; and the marks of this duplicity always remain."

49. Thirdly, in the case of the minor system of the anterior commissure, the unspecial protective versal filaments, conducting influence from the anterior inferior convolutions of the right hemisphere, and partly forming the right half of that minor system, having left the unspecial perceptive oli-versal filaments of the same side at the place where these latter leave the encephalic mass, they are reflected upwards and backwards to join the unspecial protective versal filaments of the right anterior pillar of the fornix.

50. In this diagram, representing the minor system of the anterior commissure, AE is the fasciculus, composed of an unspecial perceptive oli-versal filament, and of an unspecial protective versal filament, conducting unspecial influence in the direction AE from the anterior inferior convolutions of one side of the brain.



The perceptive oli-versal filament EBC, leaving the other at E, traverses the median plane through the anterior commissure, to gain the opposite crus cerebri BC, along which, by way of the opposite mammillary body, it reaches the opposite olivary ganglion.

lion. The protective versal filament ED, again, leaving the other at E, is reflected somewhat upwards and backwards on the corresponding crus, to join with the protective versal filaments of the corresponding anterior pillar of the fornix, and so form with it the entire protective versal fasciculus of that side.-- The line ED is here drawn, from oversight, more than four-fifths longer than it should be.

51. These two sets of unspecial protective versal filaments thus constitute the entire unspecial protective versal filaments of the three minor divisions of the right half of the great re-entrant system, which conducts unspecial protective influence from all the convolutions of the right cerebral hemisphere to the right olivary and moriform ganglions. The further course of the filaments of this entire fasciculus it is now our business to trace.

52. The right protective versal fasciculus, thus constituted, divaricates into two. One of those, almost contiguous to and parallel with the median plane, passes between this and the right optic thalamus, to gain the right side of the pineal gland, the secondary ganglion of reinforcement of the protective influence for the grey tissue of that thalamus as an organ of impression of the spirit. From the right side of that secondary ganglion, a fasciculus arises again, which proceeds to the proximal extremity of the right testis. The other portion of the entire unspecial protective versal fasciculus, trending dextrad of the median plane, passes circuitously between the right corpus striatum and right optic thalamus, and so reaches the right testis, the secondary ganglion of reinforcement of the protective influence for the right corpus striatum and right Schneiderian membrane. At the proximal side of the right testis, the two fasciculi that had separated

unite into one: which, however, immediately resolves itself into two—one passing to the right olivary ganglion—the other to the right moriform ganglion. The fasciculus from the right testis to the right olivary ganglion is well known to anatomists as the olivary fasciculus, passing from the right side of the corpora quadrigemina to the right olivary body; * that to the moriform ganglion is the right pillar of the Vieussenian valve.

53. Authorities are not wanting in confirmation of such anatomy. The author does not profess to detail his own anatomical observations on the human brain; his object is only to reduce those of others under general laws. What the learned Professor Alison has so justly observed on physiology, in the title-page, holds equally true of anatomy.

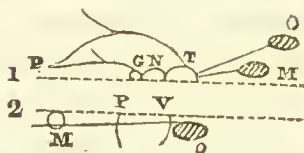
54. M. Laurencet, speaking of the anterior pillars of the fornix, in the memoir already alluded to, has these words. "These pillars," says he, "divide into two portions; the one, inferior, descends, covered again by a layer of grey substance of the optic thalamus on its internal side, attaches itself to the mammary tubercle. - - - The superior division (of the anterior pillar) divides into two parts, which proceed back upon the optic thalamus, and give origin—viz. the internal one to a little fasciculus which reaches along the edge of the ventricular face of the optic thalamus. From its junction with the opposite, behind the middle ventricle, the posterior commissure of this latter results, upon which the pineal gland is implanted. The orifice of

* Tiedemann, *loco cit.*, pp. 180, 182. In line 12 of p. 180, for "pyramidal," read olivary.

the aqueduct of Sylvius, named the anus, is below. In some mammalia, the anterior pair of the tubercula quadrigemina also result from the same little fasciculus. The other external part forms the tænia semicircularis, which passes along the base of the corpus striatum, turns externally and posteriorly of the optic thalamus, and from thence proceeds forward again, to form, with the opposite, the posterior pair of tubercula quadrigemina." It will be perceived that there is sufficient testimony here to the facts I wish to establish. Only the ingenious writer of the memoir has left out the protective portion of the minor system of the anterior commissure.—It must not be imagined that the unspecial protective versal fasciculus, passing, between the right optic thalamus and the median plane, to the right side of the pineal gland, goes no farther proximad than this. Speaking of the pineal gland—"In all mammiferous animals," says Dr Tiedemann, "its medullary pedicles arise from the superior surface of the optic chambers, and even a little from the nates." The truth is, that in all these three symmetrically double secondary ganglions of reinforcement of the protective influence, special as well as unspecial—the pineal gland, the nates, and the testes—the protective versal filaments, special and unspecial, terminate in the soft greyish unfilamentous tissue which covers these bodies; and other filaments arise afresh from the same tissue, to pass proximad to the two primary ganglions of the same side. This has been very well explained by Professor Tiedemann, in his general description of the tubercula quadrigemina.

55. In fig. 1 (on next page)—let the dotted line represent the median line; let P be the point of divarication of the entire unspecial protective versal fasciculus, conducting influence from all

the convolutions of the right cerebral hemisphere ; let α be the right half of the pineal gland, n the right half of the nates, t the right half of the testes ; and let o and m be



the right olivary and moriform ganglions. Then the curved line pt may diagrammatically represent the tænia semicircularis, while the line pg may represent, in the same manner, the right pedicle of the right half of the pineal gland. The line to may also represent the olivary fasciculus proceeding from the right testis to the right olivary ganglion ; while tm may represent the right pillar of the Vieussenian valve, proceeding from the same testis to the right moriform ganglion.—The right testis is here too large. It should be rather smaller than the natis.

56. In fig. 2—let m represent the left corpus mammillare, to which the unspecial perceptive influence is conducted, which is generated in the grey tissue of all the convolutions of the right cerebral hemisphere ; let p , v , be the points where the sincipital and sacral boundary lines of the left half of the pons Varolii meet the median dotted line ; and let o be the left olivary ganglion. Then mo may represent the left unspecial perceptive oliversal fasciculus, passing from the left corpus mammillare, through below the transverse filaments of the left side of the pons Varolii, to o , the left olivary ganglion.

57. The pathological observations which I am able to adduce in support of the above views are not so numerous as could be desired. Happily, however, there are some of those observations, on which the most distinguished writers on the encephalon are divided in opinion, which, while they corroborate the justice

of these views, also receive from them a very satisfactory explanation. "Morgagni, all the authors who have followed him, and, lastly, Professor Lallemand of Montpellier, in a work full of talent, and supported by sound observation, say *that convulsions exist on the side opposite to the palsy, and corresponding to the lesion of the brain*. M. Serres does not join in that opinion, which, to me also, appears contrary to facts. This is to say, in effect, that the action of the brain is, and is not, crossed—two things self-contradictory. If the action is crossed, the diseased side of the brain can act only upon the opposite half of the body; if the action is direct, only the corresponding side of the body can be influenced. In both cases it is impossible to attribute to the same cause, two orders of effects so different. There is, therefore, something more: as a double palsy indicates a double seat of lesion; so palsy on one side, and convulsions on the other, result from two different lesions." *

58. If the two distinguished pathologists and men of letters maintain, that in the irritation of a portion of grey tissue on the convolutions of one hemisphere, which precedes its ramollissement, and the resulting palsy of the opposite side, spasmodic muscular contractions cannot take place on both sides; then, with every submission, it must be contended that well-known pathological observations are against them. These are sufficiently numerous to show, that such contractions are present, not only on the same side as the irritation in question, but also on that where palsy follows after ramollissement is accomplished.

* M. Lacrampe Loustau, *Revue Medicale*, Mar. 1824, p. 441.

59. It must be known, that one order of unspecial versal filaments, the next to be noticed, conducts unspecial influence from the cerebral convolutions to be unspecially subservient to the voluntary contraction of muscles, from selective impressions of the spirit upon the grey tissue of the corpora striata and optic thalami. Whenever morbid influence, secreted in a portion of the grey nervous tissue on the convolutions of one cerebral hemisphere in a state of irritation, is conducted by this order of unspecial versal filaments, the spasmodic muscular contractions are on the side of the cerebro-spinal apparatus opposite to that of the pathological tissue.* But it has been seen that another order of unspecial versal filaments conducts unspecial influence from the grey tissue of the cerebral convolutions, to be subservient to the contraction of certain protective muscles from the impressions of matter. Whenever morbid influence, secreted in a portion of the grey tissue of the convolutions of one cerebral hemisphere in a state of irritation, is conducted along this order of unspecial versal filaments, constituting a part of the great re-entrant system of Dr Gall, the contractile effect is upon different sides, according as the muscles are supplied by different nerves. In the case of the protective muscles of the retinae and tongue, the irides and the genio-glossi muscles, for example, supplied by the third and ninth pairs of nerves, the spasmodic muscular contractions are on the side opposite to the lesion, or on the same side as the consequent palsy. But in the cases of the protective muscles of the apparatus of touch, supplied by the déal portions

* Andral, *loco cit.*, pp. 20, 186. Abercrombie, Edin. Medical Journal, vol. xv., p. 512.

of the unganglionated parts of the fifth pair, and the déal portions of the portio dura of the seventh pair, and their congeners which arise from the spinal cord, the muscular contractions are on the same side as the irritation of the convoluted grey tissue. Therefore, even by the present order of unspecial versal filaments, the action of the brain, as M. Lacrampe Loustau expresses it, is, indeed, crossed and not crossed. It will now easily be perceived, that from irritation of a portion of grey tissue, on the convoluted surface of one cerebral hemisphere, all the voluntary muscles of the side opposite to that of the lesion, without exception, and all the protective muscles of the apparatus of touch on the same side—viz. those which extend the thoracic and abdominal extremities—may be spasmodically contracted. In confirmation of these views, there is a case quoted by Professor Andral from M. Bouillaud, “wherein the grey substance of the convolutions was the only part of the nervous centres which had lost its consistence. This is another case, where, to account for the convulsive movements extended to both sides of the body, one hemisphere only is altered; but the meninges (on the altered side) are injured in their whole extent.”*

60. But the unspecial protective influence, after having been secreted in the grey tissue of the convolutions of the right cerebral hemisphere, may, by disorganization, be interrupted in its progress to the right olivary and moriform ganglions. I submit to the future researches of pathologists, whether coma, or loss of perceptive consciousness, is the only effect of a destructive softening of two out of three of the minor divisions of the great re-

* Andral, *loco cit.*, p. 560.

entrant system of Dr Gall. It is certain, that when consciousness is destroyed by such lesion, life can never long afterwards be maintained. It is a wise ordination, that the two orders of unspecial versal filaments constituting the great re-entrant system should be so intimately bound up together in the most fragile part of their course: so that when consciousness is destroyed, the organic functions should be so also. There is a very remarkable case furnished by Dr Andral, wherein both ascites and anasarca were present, without any of the organic disorders being discernible, from which they could arise, except a hardened liver and spleen,—in which former, however, the patient had never been aware of any ailment. The lungs, otherwise sound, were also engorged with a frothy mucosity filling the bronchi, such as when the pneumo-gastric nerves are divided in animals. After death, “destruction of the vault with three pillars and of the septum lucidum” was observed.* Might not the hardness of the liver and spleen, as well as the engorgement of the lungs, and the anasarca in this case, all have arisen from loss of functional power in the dēal filaments of the pneumo-gastric nerves, and those ramified upon the aorta and its capillaries, from deprivation of so much unspecial protective influence of the organic order?

61. Should the unspecial protective versal filaments be irritated, in any part of their course, between the places of anastomosis at the bottoms of the convolutions of the right cerebral hemisphere, and the corresponding olivary and moriform ganglions, in which they terminate; still the same rules hold, in re--

* Andral, *loco cit.*, p. 94: see also pp. 394, 396.

gard to the side on which the muscles are contracted. Rolando is said to have caused convulsions by irritating the corpus callosum. If the right natis be irritated, the left iris is contracted. There is a case of Dr Andral's,* where, on irritation of the grey tissue in the substance of the right optic thalamus, there were convulsive movements and palsy of the left arm: whereas previously, when the irritation had extended only to the grey tissue on the surface of the organ affected, the head had been spasmodically drawn to the left side by the contraction of the right rectus capitis posticus major, and other such muscles. This result evidently shows, that irritation of the unspecial protective versal filaments of the right side gives rise to the contraction of the protective muscles on that side. The induction for the unspecial must be taken from that for the special protective versal filaments. Dr Andral somewhere observes, that he has found the destruction of the septum lucidum and vault unattended by cerebral symptoms. In the pathology of the brain, however, this important principle must ever be kept in view, that when the irritation, sometimes preceding ramollissement, occurs in purely medullary unsecretive tissue, and when no morbid nervous influence is, therefore, generated, the latter state may be found without previous spasms.†

62. It is to be regretted that sufficient space is denied to illustrate the effects of irritation of the unspecial protective versal apparatus alone upon the muscular fibres supplied by the dorsal filaments of the pneumo-gastric nerves and their congeners dis-

* Andral, *loco cit.*, p. 435.

† See *Revue Medicale*, Jan. 1824, p. 56.

tributed upon the arteries and the capillaries. Let the croupy voice, the greatly compressed abdomen, the pallid cheek, the rapidly accelerated pulse, in the early stage of hydrocephalus, attest the abnormal contraction of the muscles of the larynx, of the gastro-intestinal tube, of the capillaries, and of the heart, that then prevails, from irritation of the pia-mater covering the surfaces of the corpora striata and optic thalami, and the three double ganglions of reinforcement of the protective influence, the pineal gland, the nates, and the testes.*

63. Thus the three orders of unspecial versal filaments, together constituting the great re-entrant system of Dr Gall, have been reduced under general anatomical and physiological laws. Therefore the fourth order of unspecial versal filaments, or that which conducts unspecial influence from the grey tissue of the cerebral convolutions, to be subservient to the olivary ganglions in their function of voluntarily contracting muscles from selective impressions of the spirit, now only remains to be noticed. These filaments have been said to radiate from the pyramidal fasciculi, continued sinciputad under the transverse filaments of the pons Varolii; while the other three orders, just described, have been said to converge. Such a mode of speaking, however, is inconsistent with scientific and analogical propriety. All these four orders of unspecial versal filaments, as they conduct nervous influence from the extensive convoluted surface of the brain into comparatively small fasciculi entering its olivary ganglions, must alike be considered as converging from the more

* The Morbid Anatomy of the Brain, by Alex. Munro, vol. i. Hydrocephalus. Edin. and Lond. 1827.

extensive surface to the less. The order of unspecial versal filaments under consideration has no connexion, save at the bottoms of the convolutions, with the three orders constituting the re-entrant system. Of these three latter, the former passes entirely clear. This, under consideration, is the order of filaments, of which the learned Professor Tiedemann has given a description, in his general observations, under the title "Of the Crura Cerebri, and of their expansion in the hemispheres."

64. Though some authors have contended, that certain portions of the grey tissue of the cerebral convolutions are subservient to the contraction of particular classes of muscles; still it is demonstratively certain, that if such specified parts be removed, the animals can, notwithstanding, voluntarily contract these muscles. It cannot, therefore, be upon such portions that the intellectually selective impressions of the spirit are made. This is abundantly evident from the case of the twenty-two French soldiers already mentioned, and from the fact of animals walking after some of the cerebral convolutions have been taken away.

65. The effect of the unspecial influence, conducted from the grey tissue of the convolutions of one hemisphere, is manifested by the contraction of the voluntary muscles on the opposite side of the body. The unspecial influence, for example, from the grey tissue of the convolutions of the right cerebral hemisphere, is transmitted, by the present order of unspecial versal filaments, to the olivary ganglion of the same side; and the transition of the influence across the median plane, is made by means of *déal* filaments, as will afterwards be shewn, crossing the median plane of the cerebro-spinal apparatus.

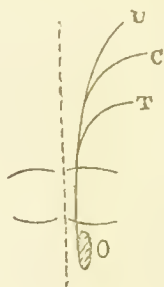
66. The justice of these views is corroborated by pathological

phenomena. Should the secretion of the unspecial influence, which passes by this order of unspecial musculo-oliversal filaments, be abolished in one cerebral hemisphere; as, for instance, by a pathological condition of the corresponding superior cervical ganglion, whose filaments supply the nervous plexus of the carotid artery, whose capillaries are distributed on the grey tissue of the convolutions of that same hemisphere: then it is evident that the selective impressions cannot effect voluntary muscular contractions on the opposite side of the body. It must be observed, that the grey tissue of the corpora striata and optic thalami receive their capillaries, as well as the nervous plexus of their vessels, from the same vascular and nervous sources—viz. the internal carotid arteries, and the superior cervical ganglions. This pathological state of the corresponding superior cervical ganglion may arise, either from its own organic condition, or that of some of its congeners of the sympathetic system. The individual, who, while lying in catalepsy, heard all the arrangements made for her own funeral, without ability to manifest, by muscular motion or voice, that she was alive, may probably have suffered from a morbid condition of the sympathetic ganglions.* The secretive function of the corresponding sympathetic superior cervical ganglion may also be impaired by irritation of its symiversal filaments from ulceration of a part of the brain, on whose arteries and capillaries they are ramified in plexuses. In this way ramollissement of a portion of the unspecial grey tissue, or cerebro-versal fasciculi leading from it, in one cerebral hemisphere, may cause palsy of both the oppo-

* Cyclopædia of Practical Medicine, art. *Catalepsy*.

site thoracic and abdominal extremities. The unspecial influence transmitted from the convoluted grey tissue along this order of unspecial versal filaments may also be morbidly augmented: and, as the palsy, in the case last mentioned, was in the muscles of the opposite side; so, in this case, the spasmodic contractions are also on the opposite side (59.)

67. Let *o* be the right olivary ganglion; let *uo* represent all the unspecial musculo-oli-versal filaments, conducting influence from the convolutions of the right cerebral hemisphere, to be unspecially subservient to voluntary muscular contraction on the left side of the body; let the points *c* and *t* represent the grey tissue respectively of the right corpus striatum and right optic thalamus. Then may the curved lines *co* and *to* represent the special oli-versal filaments, proceeding from the grey tissue just mentioned, to be conjoined with the unspecial musculo-oli-versal fasciculus represented by the filament *uo*, and usually described by anatomists as a continuation of the right pyramidal fasciculus, whose filaments radiate into the right cerebral convolutions.



68. An opinion seems to prevail amongst physiologists and pathologists, that the olivary and moriform ganglions, with their appertaining unspecial versal apparatuses, are almost exclusively devoted to the functions of perceptive consciousness of the impressions of spirit and of matter, and to voluntary and involuntary contraction of the larger muscles. Accordingly, the phenomena of the cerebro-spinal system have been named of animal life; while those of the sympathetic system have been

named of organic life. Nothing can well be more remote from the truth. The great importance of the unspecial influence secreted in the grey tissue of the cerebral convolutions, in the functions of the organs supplied by the d  al filaments of the pneumo-gastric nerves, as well as their congeners distributed upon the arteries and the capillaries and veins, is very evidently manifested from many pathological observations. The effects of a healthy secretion of the unspecial influence, upon the muscular fibres supplied by the d  al filaments of the pneumo-gastric nerves, are manifested by the morbid secretion which takes place in the early stage of meningitis. "Vomiting, or at least nausea," says Professor Andral, "very frequently accompanies acute inflammation of the meninges. These phenomena are present almost exclusively in the earlier stage of the complaint, and they often mark the onset of it. - - - At the same time that these vomitings take place, it frequently happens that nothing uncommon is observed in the digestive passages. The tongue remains natural; the epigastrium is indolent; all the abdomen is perfectly supple; and, in the cases which proved fatal, when those vomitings also existed, the stomach has been found in the healthiest state."* Thus, as the physiological subserviency of the unspecial influence secreted in the grey tissue of the cerebral convolutions, in the contraction of the muscles of voluntary motion on the opposite side, is demonstrated by the pathological contractions of these in meningitis; so, the physiological subserviency of the same influence to the contraction of the muscular fibres of the gastro-intestinal tube, is demonstrated by the spasmodic contraction of these

* Andral, *loco cit.*, p. 212.

fibres in the same disease. Doubtless, as Professor Andral very justly observes, vomiting arises from meningitis in any part of the surface of the brain, just as the same is attendant upon inflammation of the liver or irritation of the kidney; but this may arise from irritation of the sympathetic as well as of the cerebro-spinal system. Notwithstanding, however, the unspecial influence subservient to the organic functions is derived from the blood in the capillaries of the grey tissue, and not from that in those of the medullary tissue of the brain.—Partly from want of space, and partly for the purpose of not diverting too much the attention from the contemplation of general laws, I defer at present the illustration of the influence of the unspecial nervous aura secreted in the cerebral convolutions, upon the dorsal filaments supplying the heart, the arteries, and capillaries.

69. Such are the anatomy and physiology of the unspecial versal apparatuses of the olivary ganglions, constituting the cerebrum proper. Those of the unspecial versal apparatus of the moriform ganglions are perfectly analogous,—only more simple, as the functions of these ganglions are fewer in number. The great scientific position, upon which both these unspecial versal apparatuses must be studied, is, that the special versal filaments combine with the unspecial versal filaments, before these latter enter the body of the ganglion itself. The great characteristic distinction between the convoluted surfaces of the grey tissue of the cerebrum and cerebellum, is, that, whereas in the former the line of section of a plane passing perpendicular to the median line of a convolution, is only singly plicated; in the latter, it is doubly so. Let the parallel laminæ of the cerebellum be cut by a plane as nearly as possible perpendicular to their planes, and

passing as nearly as possible through their middles and centres of curvature ; then, not only will the line of section of the surface be deeply plicated inwards, but the in-entrant lines, the sections of the internal surfaces of the laminæ, will also themselves again be plicated, though not so deeply. There will be a plication of the line of section of the surface to give the laminæ ; and a plication of the lines of section of the internal sides of the laminæ to give the arborised form to the white medullary tissue, which conducts away the unspecial influence from the grey tissue : the sole object of such arrangement being to increase the surface of this. All the laminæ, as well as the branches of the arborisation, are directed towards the moriform ganglions of the respective hemispheres. The student need not perplex himself about the curious disposition of the plications. They are to be studied on two fundamental principles : first, that within a given volume, the surface of the secretive grey tissue might be as extensive as possible ; secondly, that it should lie in contact with the unspecial mori-versal filaments leading to the moriform ganglions. Certainly, for these two purposes, the mutual disposition of the two tissues, the grey and the medullary, is curious and beautiful in the extreme. Anteriorly and posteriorly on the median plane, how beautifully are the laminæ wormed in !

70. But whether the unspecial grey tissue appertaining to the olivary and moriform ganglions, as it lies in contact with the distal extremities of the unspecial versal filaments leading to these primary cerebro-spinal nervous centres, be disposed in a plane or a convoluted surface, affects not the truth of the fundamental scientific laws contained in this work, in their application to the comparative anatomy of the encephalon, more espe-

cially of the vertebrate animals. The surface of that tissue is convoluted in the higher orders of animals, just for the same reason that it is more extended backwards:—that is, for the secretion of a larger quantity of unspecial nervous influence, to be subservient to the functions of perceptive consciousness, as well as of muscular motion. Mark what a moral lethargy prevailed in the patient of Dr Martinet, whose apparatuses of perceptive consciousness were deprived of the unspecial perceptive influence conducted by the perceptive portions of the two greater divisions of the re-entrant system; as well as the effect of the deprivation of the system of the corpus callosum, in the idiot woman mentioned by Reil. When we consider the great corporeal masses some of the higher mammalia have to put in motion, against inertia and the constantly acting power of gravity, it must be evident that they require a vast expenditure of nervous aura to contract their muscles. Fishes that float in their native element, which supports them in a proper position with very little muscular exertion, are in a very different predicament. What a vast expenditure of nervous influence would be required to move a land animal of five hundred tons!—while a single horse could drag a laden vessel of that burden along a canal.

71. These remarks are called forth on the present occasion, by some objections against Dr Gall, whose ingenious researches, on the anatomy of the brain at least, are well entitled to the defence of every true lover of medical science. Dr Tiedemann, if rightly understood, would seem to contend, that because the grey tissue on the surface of the cerebral hemispheres is of small extent, and plane and unconvoluted in its surface, it should not proportionally be provided with its proper medullary appurte-

nances. But, with every submission to the learning of this distinguished Professor, and every due regard for the great value of his researches on the structure and developement of the human brain in its foetal state, it must be contended that the geometrical disposition of the unspecial grey tissue of the cerebral hemispheres does not affect the doctrine of the existence of the re-entrant system of Dr Gall. The unspecial influence is secreted under any disposition of its glandular tissue, whether plane or convoluted; only in less quantity, in the former of these cases. In animals, where the surface of that tissue is of small extent, and plane in its disposition, and where two of the divisions of the great re-entrant system—viz., those of the corpus callosum and fornix—are wanting, and where only that of the anterior commissure is persistent, why should the same combination and transmission of filaments not be found to obtain in this, as in the two other divisions, now no longer required? If the former division was independent before, why not so now? The words of Dr Tiedemann are these: and let it be observed how exactly the description is conformable to the views already laid down of the anastomosis, near the unspecial grey tissue, of the unspecial motor oli-versal filaments with those of the re-entrant system. “On cautiously separating,” says he, “the superior part of the hemispheres of the brain of the frog, toad, lizard, snake, tortoise, and that of birds, we observe that they are nearly separated by a groove, and merely connected together by a small transverse cord of medullary substance which dips into each hemisphere. This cord having passed under the protuberances analogous to the corpora striata, expands into a certain number of fibres which are lost in the substance of the hemispheres, and anasto-

mose with those of the crura cerebri. As there are no convolutions on the brain of these animals, and as they possess an anterior commissure, we perceive that M. Gall has been deceived in supposing this latter to arise from the convolutions, observing, that it is composed of re-entrant fibres.”* Again, to the same import. “M. Gall regards it”—viz. the anterior commissure—says the learned Professor, “as belonging, with the posterior commissure and corpus callosum, to a system of organs, composed of converging fibres, which he supposes to arise from the grey substance of the convolutions of the brain. These re-entrant fibres are imaginary objects, and do not naturally exist, as I shall hereafter show. He observes that the anterior commissure is formed by the re-entrant fibres arising from the anterior convolutions of the middle lobes, and from some of those near the fissure of Sylvius, and that these fibres proceed inwards in order to form it by their union. The following facts show that he is equally wrong in this point. The anterior commissure exists in the brain of fœtuses of three and four months, consequently at a period when there are no convolutions, for these latter appear only at a subsequent period. It cannot, then, be formed of the converging fibres of parts which are not yet in existence.”† As if the convoluted grey tissue, and not the Almighty Author of nature, made the brain of man! Just about that part where the internal carotid arteries arrive at the brain, is the unspecial grey tissue on the cerebral hemispheres found, which transmits towards the median plane the unspecial versal filaments, constituting that one of the three divisions of the great

* Tiedemann, *loco cit.*, p. 223.

† *Ibidem*, p. 221.

re-entrant system of the ingenious Dr Gall, which is the longest presistent as we descend in the scale of vertebrate animals, and the first developed in the human fœtus. That is the whole secret of the matter, as the distinguished writer on the comparative anatomy of the brain has so very philosophically shown. As for the posterior commissure of the brain, it belongs not to the unspecial, but to the special versal apparatuses of the olivary and moriform ganglions.

ON THE SPECIAL VERSAL APPARATUSES OF THE OLIVARY AND MORIFORM GANGLIONS.

72. HAVING now stated, and very briefly illustrated, the scientific laws of the unspecial versal apparatuses of the olivary and moriform ganglions, the special versal apparatuses of these nervous centres come next under consideration; and here those of the olivary ganglions would claim first to be noticed. But as the unspecial influence from the grey tissue of the cerebral convolutions is transmitted, not only by unspecial perceptive olivarsal filaments, to the olivary ganglions of the opposite side, but also by unspecial protective versal filaments, to the olivary ganglions only, of the same side,—the special influence, arising from the impressions of spirit and of matter upon the grey tissue of the distal organs of impression of the apparatus of perceptive consciousness, is transmitted, not only by special perceptive olivarsal filaments, to the olivary ganglions of the opposite side, but also by special protective versal filaments, both to the olivary and moriform ganglions of the same side. Therefore it is

evident, that, in laying down the scientific laws or positions of the special versal apparatuses of the olivary ganglions, the special versal apparatuses of the moriform ganglions must also come under consideration. As has already been observed, it is one of the peculiar offices of the olivary ganglions to be the primary nervous centres in the cerebro-spinal apparatus, to which the unspecial influence subservient to perceptive consciousness is carried by unspecial versal filaments; but, at the same time, it is their office, in conjunction with the moriform ganglions, to be subservient to the protection of the organs of impression of the perceptive apparatuses from the pathological effects of noxious or violently acting agents.

73. The phenomena of perceptive consciousness, arising from the impressions of matter, are smell, sight, hearing, taste, and touch; those arising from impressions of spirit are memory, fancy, and the consciousness of the power of contracting muscular fibres. Now the first scientific position to be laid down, concerning the mode in which these phenomena are produced, is, that a nervous influence or aura is eliminated from the blood in the capillaries of the grey tissue of the distal organs of impression of the perceptive apparatuses, in consequence of the impressions of the spirit and of matter. In the instances of smell, sight, hearing, taste, and touch, these distal organs are, respectively, the Schneiderian membranes, the retinæ, the grey nervous tissue of the auditory nerves in the labyrinths of the ears, of the mucous membrane of both sides of the tongue, and of the whole skin of the body; in the instances of memory, fancy, and consciousness of the power of contracting muscular fibres, the distal organs of impression, it is presumed, are the grey tissue of the corpora striata and optic thalami.

74. That such an influence, although imperceptible by man, is yet a real physicial entity, eliminated from the blood in the capillaries of such grey tissue, appears from many considerations. A number of pencils of light, for example, impinging upon a portion of the surface of a retina, whose secretive function is abnormal, will sometimes cause the sight of colours entirely different from what they would occasion if impinging upon a sound retina. Such difference of effect as to perceptive consciousness, from the same impression, cannot at all be accounted for upon the principle of vibration ; and the idea that light can be propagated along the opaque optic nerves, is altogether contradictory to the laws of physics. The very same influence which, passing along one fasciculus of filaments, gives sight of the picture covering the retina, also, when simultaneously transmitted by another fasciculus of filaments, contracts the sphincter muscles of the irides. The correlation of the filaments, conducting the variously modified secretions from the various points of impingement of the differently coloured pencils of light, gives the consciousness of the correlation of the variously coloured points upon the retina : and it is in the organ of its residence that the soul itself is impressed by such secretions. But the same varied secretions, passing along another fasciculus of nervous filaments through the primary cerebro-spinal ganglions, pass by *déal* filaments to an ultimate destination, where there is nothing to perceive, or to give different effects to, the variety, and where they one and all merely serve to perform the same function—that is, the contraction of the irides.

75. Such special influence is eliminated from the blood by the instrumentality of the nervous filaments which surround, in plex-

uses, the arteries, capillaries, and veins of the grey tissue of these distal organs of impression. In the grey tissue of the retinae, and in that of the corpora striata and optic thalami, shut in from pathological impressions, except through the medium of the blood, the nervous plexuses are those of the internal carotid arteries, whose filaments are entirely derived from the sympathetic superior cervical ganglion: the nervous plexuses, again, of the arteries of the grey tissue of the auditory nerves in the labyrinths of the ear, are divided from the plexuses of the vertebral arteries whose filaments are derived from the inferior cervical ganglions. But the nervous plexuses of the arteries, capillaries, and veins of the Schneiderian membranes, and of the mucous membrane of the tongue, and of the skin of the whole body, are composed, partly of filaments proceeding from the sympathetic ganglions, and partly of cerebro-spinal filaments passing independently and freely of these nervous centres, as was shown in the case of the external carotid artery. There is a still more important anatomical distinction, however, between the two sorts of grey tissue above mentioned. The latter is supplied with fasciculi from the ganglions of Gasser, and its congeners formed on the filaments from the posterior columns of the spinal cord; whereas the former is not. Now, in the description of the special versal apparatus of touch, it will be shown that these fasciculi are composed, not only of special perceptive olivary filaments, conducting influence to the olivary ganglions to be subservient to touch, but also of another order of filaments, conducting influence to the primary cerebro-spinal ganglions of the same side, by which the muscular fibres of the arteries are contracted, the contents of the capillaries are circulated, and the

glandular products eliminated from these. It is upon this anatomical distinction, and upon the different nature of the nervous plexuses of their blood-vessels, that not only the difference of impressibility as to pain from mechanical irritants, in the two sorts of grey tissue just noticed, but also the results of M. Majendie's experiments upon the functions of the fifth pair in smell, depend. The grey tissue of the retinae, of the expansions of the auditory nerves in the labyrinths of the ear, of the corpora striata, and optic thalami, physiologically deprived of the fasciculi of the ganglions of Gasser, and having no other nervous endowment but that from the sympathetic superior cervical ganglions, whose filaments are distributed in plexuses upon its arteries, is unimpressible as to pain when mechanically irritated. But the grey nervous tissue in the cheek of M. Serres' patient, although pathologically deprived of the filaments of the ganglion of Gasser, was still impressible as to touch from the presence of cerebral filaments in the plexuses of its arteries, which pass to these freely and independently of the superior cervical ganglions. If M. Majendie contend, that the fasciculi of the ganglions of Gasser are the nerves of smell, he is decidedly mistaken. Because, when he isolates the Schneiderian membranes from those ganglions, he finds these membranes no longer impressible as to smell, it must not be concluded that the influence subservient to such effect passes along the fasciculi in question. By such isolation he has only impaired the secretive functions of the membranes above-mentioned to such an extent, that the nervous influence eliminated from the blood in their capillaries, is no longer sufficient to excite consciousness. He has deprived these membranes of one channel, by which the influence of the im-

pression of the odorous body is carried to the primary ganglions, by the instrumentality of whose déal filaments the nervous aura is eliminated from the blood. Witness the effect of isolation of the eye from the fasciculi of the corresponding ganglion of Gasser : its secretions are gradually diminished, and its organization destroyed. Witness also the effect of isolation of the right side of the tongue, in M. Serres' patient, from the right Gasserian ganglion. On the application of powerful stimulants, that side no longer pours forth its mucous secretion ; neither are the salivary glands of the same side excited. The nervous aura subservient both to smell and sneezing passes in verity by the olfactory nerves, and not by the fasciculi of the ganglions of Gasser ; though these are essentially necessary to the secretion of that aura in the grey tissue of the Schneiderian membranes. Cut the olfactory nerves, and neither sneezing nor the smell of odours can be effected from the usual impressions. It is possible, indeed, that those membranes, under such circumstances, may still be impressible as to the touch of acid fumes and alkaline vapours ; just as the mucous membrane of the tongue, with the same nervous endowment, is impressible as to taste from sapid bodies : but it yet remains to be proved that the fasciculi of the ganglions of Gasser carry proximad the nervous aura which produces, in the proper organ of consciousness, the smell of delicate odours.

76. The mode in which this special nervous influence is eliminated from the blood in the capillaries of the grey tissue of the distal organs of impression of the apparatuses of perceptive consciousness, is one of the most difficult subjects I have encountered in these researches, and has not received from physiologists all the attention it merits. Such special influence, it is evident,

must, like every secretion from the blood, be eliminated from that fluid by the instrumentality of the ganglions whose filaments, in plexuses, supply the capillaries which circulate it. But no nervous aura or influence, considered as a real entity or fluid, can, in the first place, be transmitted to these ganglions. Before it can be transmitted, it must first be secreted. It is probable, then, that the impressions of spirit and of matter upon the grey tissue of the distal organs of impression of the apparatuses of perceptive consciousness, must influence such primary ganglions, by the vibration they occasion upon that tissue being communicated by the grey nervous filaments to these primary nervous centres, and that from these again an aura is transmitted, by which the special influence in question is eliminated from the blood of the capillaries of such tissue. Accordingly the economy, not only of the sympathetic, but also of the cerebro-spinal system of nerves, is strongly corroborative of such a supposition.

77. "After what has been said above," says Bichat, "it is evident that the nerves proceeding from (sympathetic) ganglions are of two sorts in regard to their organization. First, those which are identical with the cerebro-spinal system in their white colour, in the possibility of dividing their trunks into distinct cords, and these into filaments, which appear neurilematous and medullary like the preceding; secondly, those which present only small filaments, unconnected, greyish or reddish, soft, and which are to be especially seen in prodigious number in the plexuses."* Such grey filaments, however, are not peculiar to the

* *Anatomie Generale, precedee des Recherches Physiologiques sur la Vie et la Mort*, par X. Bichat. A Paris, 1818, tom. i. p. 241.

sympathetic ganglions. Anatomists must be well aware of the perfect symmetry with which the grey tissue is distributed, in relation to its ganglions, in the cerebro-spinal system of nerves. Are there not the dark crescents, the *taches noires*, in the cerebral peduncles, with the interpeduncular grey web, extending as far as the proximal side of the tuber cinereum, composed of the secondary ganglions of reinforcement of the perceptive influence for the olfactory and optic apparatuses? Then, is there not likewise the web of grey tissue between the sincipital peduncles of the moriform ganglions—the pillars of the Vieussenian valve—extending as far as the testes, the proximal secondary ganglions of reinforcement of the protective influence for the Schneiderian membranes, and the grey tissue of the corpora striata? Only observe with what perfect symmetry the moriform web passes sacrad between the sacral peduncles of the moriform ganglions, till it reach and coalesce with the sacral olivary web:—both together forming that grey tissue which intervenes between the grey crescents of the spinal cord, with their convexities centrad, their concavities dextrad and sinistrad, and their horns ventrad and dorsad. Now from the grey tissue, thus symmetrically disposed, a grey filament is sent off, not only along every fasciculus going to a distal organ of impression in the apparatuses of perceptive consciousness, but also along every cerebro-déal fasciculus. Such grey filaments, in the case of the olfactory apparatus, are called by M. Cloquet the grey roots of the olfactory nerves. It is owing to the presence of such grey filaments, that the distal extremities of the proximal segments of the optic nerves, divided between the retinae and the commissure, are impressible, as to

the contraction of the irides, on mechanical irritation.* From the same cause, the fasciculi of the ganglion of Gasser, and their congeners formed from the posterior columns of the spinal cord, are impressible as to pain from the same sort of irritation. In these instances, a certain quantity of nervous influence is secreted in the grey tissue on being mechanically irritated, which being carried proximad by conductive medullary filaments, gives rise to the phenomena just mentioned. The presence of such grey filaments, again, in the cerebro-déal filaments, renders them impressible as to the contraction of the muscles on which they are distributed. The influence generated in this case by irritation of the grey filament, is carried distal by the medullary filaments. Does not the third pair of nerves derive grey filaments from the *taches noires*? Does not the fourth pair, rising on the median edges of the sincipital peduncles of the moriform ganglions, derive grey filaments from the valve of Vieussens? Do not the cerebro-déal filaments of the spinal cord derive grey roots from the anterior horns of the crescents of the grey tissue in the centre of that cord?

78. I might here have precisely stated the mode in which vibrations passed to the primary cerebro-spinal and sympathetic ganglions in the several apparatuses of perceptive consciousness. But as the consideration of such a subject would involve the déal apparatus of the olivary and moriform ganglions, it would be here somewhat premature; besides, it would too much distract the attention from the contemplation of the great and fundamen-

* A Practical Treatise on the Diseases of the Eye, by William Mackenzie, London, 1830, p. 771.

tal laws immediately to be laid down in the science of the apparatuses of perceptive consciousness. It may suffice merely to state, that while the vibration from the impression is carried to the primary ganglions, the influence returned from these, and by which the nervous influence is eliminated from the blood in the capillaries of the distal organs of impression, is transmitted by medullary filaments. It may also be worth while to notice, that the doctrine of vibration is strongly corroborated by the want of impressibility, as to pain, of the hard tissues, such as the bones in their physiological state, contrasted with the great delicacy of impressibility in such tissues as the retinæ, and the auditory nerves in the labyrinths of the ears.

79. But in whatsoever manner it is eliminated from the blood in the capillaries of the grey tissue of the distal organs of impression of the apparatuses of perceptive consciousness, from the impressions of spirit and of matter, the special influence or aura is transmitted from that same tissue by three several orders of filaments, to be subservient to as many purposes in the economy of the cerebro-spinal system of nerves.

80. First—by one order, that of the perceptive oli-versal filaments, that influence is conducted, from the grey tissue of the distal organs of impression of the apparatuses of perceptive consciousness on one side, to the olivary ganglion of the opposite side. But before these perceptive oli-versal filaments reach this destination, in order that the influence which they conduct may take proper effect, they must combine with the unspecial perceptive oli-versal fasciculus, conducting influence from the grey tissue of the convolutions of the corresponding cerebral hemisphere, which, however, also passes, as has been seen, to the same des-

tion. In this way, it is perceived, a flood of influence, both unspecial and special, passes to the organ of perceptive consciousness, on every special impression from spirit and from matter. The special impression is subservient to the secretion of the unspecial, as well as the special influence ; because the sympathetic ganglions, whose filaments in plexuses surround the arteries of the special grey tissue of the distal organ of impression of an apparatus of perceptive consciousness, are on the same side of the body as those whose filaments in plexuses accompany the branches of the internal carotid artery which are distributed upon the grey tissue of the corresponding hemisphere of the brain. Thus, for example, the impression of light upon the right retina, being carried to the right sympathetic superior cervical ganglion, whose filaments in plexuses surround the right internal carotid artery and its branches, which supply the grey tissue of the right retina, and that of the convolutions of the right cerebral hemisphere, both these portions of grey tissue are thrown into secretive action, and the influence, special as well as unspecial, thence arising, is transmitted to the left olivary ganglion. Exactly the same description, *mutatis mutandis*, applies to the other apparatuses of perceptive consciousness. If it be asked, how the conclusion was arrived at, that the unspecial as well as special perceptive oli-versal filaments, as well as the influences which they respectively conduct, pass to the opposite olivary ganglion ?—it may be replied, By transcendental reasoning such as this :— Assuming it as an incontrovertible and established law, that the simultaneous flow of special and unspecial influence must take place from the same side of the cerebro-spinal apparatus to the same olivary ganglion on one side or other ; then, if it can

be shown, from anatomical description, that the unspecial perceptive oli-versal filaments traverse the median plane of that apparatus, the special perceptive oli-versal filaments must also traverse that plane : or, on the other hand, if it can be shewn, from pathological observations, that, in one single instance, the special perceptive oli-versal filaments traverse the same plane, then not only the special perceptive oli-versal filaments, in every other instance, but also the unspecial perceptive oli-versal filaments, must traverse it. Now, the single instance, in which the special perceptive oli-versal filaments traverse the median plane in question, is to be found in the optic apparatus, where, from an observation of Dr Martinet,* it appears that the perceptive oli-versal filaments from the right retina, for example, traverse that plane at the commissure of the optic nerves, to reach the unspecial perceptive oli-versal fasciculus at the inner edge of the left crus cerebri going to the left olivary ganglion (36).—By such transcendental reasoning, the mastery of which could only be attained by long-continued and severe study, I became assured, that not only the unspecial perceptive oli-versal filaments, conducting influence from the grey tissue of the convolutions of the right cerebral hemisphere, and forming a part of the great re-entrant system of Dr Gall, but also the special perceptive oli-versal filaments from the right Schneiderian membrane, from the grey tissue of the right corpus striatum, from that of the right optic thalamus, from that of the auditory nerve in the labyrinths of the right ear, from that of the right side of the tongue, and from that of the whole of the right side of the body, traverse

* Manual of Pathology, *loco cit.*, p. 134., art. 422.

the median plane of the cerebro-spinal apparatus, to reach the left olivary ganglion. This was a most important conclusion, for it afforded me complete assurance of the truth of some positions of which I had been previously in doubt: of the truth of the law from which the conclusion was drawn, there can be no doubt. Now, from this conclusion we are enabled to trace the special perceptive oli-versal filaments from the right Schneiderian membrane, across the median plane of the cerebro-spinal apparatus at the anterior commissure, the same as in the lower animals; also to trace the special perceptive oli-versal filaments from the grey tissue of the right corpus striatum, across that median plane at the same place; also to trace the perceptive oli-versal fasciculus, from the grey tissue of the right optic thalamus to the left mammillary body; and also the special perceptive oli-versal filaments, from the grey tissue of the right auditory nerve in the labyrinths of the right ear, from the grey tissue on the right side of the mucous membrane of the tongue, and from the grey tissue on the skin of the whole body,—together composing the superficial transverse filaments of the right side of the pons Varolii,—all to the unspecial perceptive oli-versal fasciculus on the edge of the left crus cerebri, as it passes immediately sinistrad of the median septum of the tuber annulare, below its transverse superficial filaments on the left side, before it terminates at the left olivary ganglion. Such is the transcendental anatomy of the perceptive oli-versal filaments, special as well as unspecial, of the different apparatuses of perceptive consciousness.

81. Secondly—by another order of filaments,—that of the protective versal filaments of the muscular order,—a portion of the same special influence, from the grey tissue of the distal

organs of impression of the apparatuses of perceptive consciousness, is simultaneously transmitted to the olivary and moriform ganglions of the same side, to be subservient to the contraction of the larger muscles, whose office is to protect such distal organs from the effects of noxious agents, or to aid these organs in their functions. By the contraction of such protective muscles, these organs are either shut in or removed from the offending body, or this itself is driven away. Thus the retina is shut in from excessive light by the contraction of the iris ; the Schneiderian membrane is raised from the offending vapour by the involuntary contraction of the elevator muscles of the head, or the sternutatory is expelled from the nostrils by the contraction of the expiratory muscles. Thus, also, by the contraction of extensor muscles, the hand is drawn away from contact with a mechanical or chemical irritant. By means of influence passing along this order of filaments, certain muscles, it has been said, are contracted, which aid the distal organs of impression in question in their functions. We have an example of this in the contraction of the inspiratory muscles upon the impression of an odorous body on the Schneiderian membranes, causing an influx of air through the nostrils ; also in the adaptation of the eye to the sight of near objects by the contraction of the muscles of the eyes supplied by the third pair of nerves, the same that supply the irides ;* also in the bracing of the tympanum by the contraction of the musculus tensor tympani, supplied by a fasciculus from the porta dura of the seventh nerve ; also in the movements of the tongue and fingers on the contact of bodies we wish to taste

* Mackenzie, *loco cit.*, p. 695.

and to touch. Another set of protective muscles must here be noticed as deserving attention, since they belong to all the apparatuses of perceptive consciousness. I mean the muscles of inspiration, more especially the sterno-mastoid and the trapezii. By the contraction of these muscles the capacity of the thorax is enlarged, the capillaries of the pulmonary artery are dilated, and an afflux of blood consequently takes place from the capillaries of the whole aortic system. This was beautifully shewn by the experiments of Dr Barry, who found that, at every inspiration, an increased flow of fluid took place along the tubes which he had connected with the veins of the animal. Thus the liability of the morbidly impressed tissue of the distal organ of impression of the apparatus of perceptive consciousness to inflammation, is obviated by the simultaneous depletion of its capillaries. In the olfactory apparatus, the contraction of the protective inspiratory muscles above-mentioned, is well illustrated by the inspiration which always precedes the expiratory act in sneezing, from a sternutatory to the nostrils. In the case of the optic apparatus, the contraction of the same inspiratory protective muscles is shown, either by the primary inspiration in sneezing from looking directly at the bright noon-day sun, or by the sudden inspiration and shrug of the shoulders, or start, from a flash of lightning. In the same manner, in the case of the auditory apparatus, the contraction of the same inspiratory muscles is shewn, by the involuntary sigh and start from a violent vibration of the air upon the tympana, as when a gun or cannon is suddenly and unknowingly fired off. Likewise, in the case of the apparatus of touch, the contraction of the same protective inspiratory muscles is evident, from the sudden inspiration and

elevation of the shoulders, when the skin is mechanically or chemically irritated,—as when it is pricked with a needle, or when cold water is dashed upon it, or when a person enters the cold bath. It is the impression of the cold bath of our atmosphere, upon the skin of the newly born infant, that contracts its muscles of inspiration, and so dilates its thorax, and forces the air by pressure into the cells of the lungs. The success of several therapeutic means of resuscitation altogether depends upon the sudden contraction of the protective inspiratory muscles in question, from powerful impressions upon the distal organs of impression of the apparatuses of perceptive consciousness. The application of carbonate of ammonia to the nostrils ; the dashing of cold water over the face ; the lifting up of the eyelids in a state of insensibility, are familiar to all. The prize-fighter falls insensible from a blow upon the head or stomach : his nervous system is concussed. What is to be done ? His second pours a flagon of cold spring water over his head ; he heaves a deep sigh ; opens his eyes ; and is just ready in due time, again to face his antagonist. The student, in the laboratory of practical chemistry, receives a whiff of the hydrocyanic acid as it is being manufactured, and falls prostrate—to every appearance dead. What shall be done ? Shall ammonia be applied to his nose ?—shall he be poured down through a pipe into his stomach ?—shall he be bled in the jugular vein ?—or shall he have a tobacco enema ? They know better things. His charitable companions run for the nearest canful of cold spring water, and souse it all over him. He heaves a deep sigh, opens his eyes, and starts to his feet, resolved fully to repay such kindness whenever a suitable opportunity shall offer. Such instances are familiar to every

one ; but the nervous machinery, by which the contraction of the inspiratory muscles is effected, is not so generally known. The morbid impression gives rise to the secretion of a quantity of nervous influence, which being carried, by protective versal filaments of the muscular order, to the primary cerebro-spinal ganglions of the same side, a quantity of nervous influence is again sent along d  al filaments to contract the muscles just mentioned. In the case of the olfactory and optic apparatuses, the distinct existence of the protective versal filaments of this order, by which the protective influence is conveyed proximad into the d  al filaments supplying such inspiratory muscles, is not manifest ; because, during their whole course, such versal filaments are bound up in one fasciculus with the protective versal filaments of the organic order next to be noticed. This is not the case, however, with the apparatuses of hearing and of touch. In the former of these, the protective versal filaments, carrying back the inspiratory influence, join the portio dura of the seventh pair, of which they form a versal part, leaving the other two orders of filaments, before these reach the encephalic mass. In the latter of these apparatuses, the protective versal filaments, carrying back the inspiratory influence, leave the other two orders of filaments, immediately on leaving the skin, and take an entirely separate course. The protective versal inspiratory filaments of the apparatus of touch may conveniently be divided into two sets—one for the skin of the face and head, another for the skin of the whole body. The first set consist of a portion of the versal part of the portio dura of the seventh pair of nerves, and of a portion of the versal part of the unganglionated portion of the fifth pair ; the second set consist of a portion of the nervi accessorii. Thus the

former of these sets performs the same inspiratory protective act for the skin of the face that the latter does to the skin of the trunk. It will, no doubt, be said that the *nervi accessorii* are *déal* filaments, carrying nervous influence distad, by which muscular fibres are contracted. All that shall be replied at present is, that I positively know the reverse ; and that no *déal* filaments arise from the superficial medullary lateral columns of the spinal cord. The protective versal filaments of the *nervi accessorii*, proceeding from the skin of the trunk and extremities, and forming a part of the lateral columns of the spinal cord, merely associate themselves with the *déal* filaments, conducting influence distad, by which the sterno-mastoid and trapezii muscles are contracted, from impressions of spirit and of matter : just in the same manner as the protective versal portions of the *portio dura* of the seventh pair, and of the unganglionated part of the fifth pair, after leaving the skin of the face and head, and before reaching the encephalon, associate themselves with *déal* portions of the same nerves ; and in the same manner as other protective versal portions of the *nervi accessorii* themselves join the hypo-glossal nerves. On account of this association last-mentioned, from sudden impressions upon the skin, the jaw is apt to be depressed. Now the same great and fundamental law, of association of special with unspecial versal filaments, obtains in this order, as in that of the special perceptive oli-versal filaments. The special protective versal, must combine with the unspecial protective versal filaments, before these latter reach their respective ganglions : the special oli-versal fasciculi, with the unspecial oli-versal fasciculus of the same side ; and the special mori-versal fasciculi, with the unspecial mori-versal fasciculus of the same side.

In art. 32, I had occasion to state it as a general law, that the unspecial protective versal filaments from the convolutions of the right cerebral hemisphere, simultaneously conduct influence to the right olivary and moriform ganglions. I have since, however, found it proper to modify that opinion, and to conclude that the unspecial influence from the unspecial grey tissue of a primary cerebro-spinal ganglion, passes only to that ganglion, or its symmetrical congener. Therefore the medullary fasciculus, from the right testis to the right olivary ganglion, must alone be regarded as the unspecial protective oli-versal fasciculus, conducting protective influence from the convolutions of the right cerebral hemisphere; and the right pillar of the Vieussenian valve must be regarded as entirely a special protective mori-versal fasciculus, conducting special influence to the right moriform ganglion, and associating with the unspecial protective mori-versal fasciculus, proceeding from the unspecial grey tissue of the right hemisphere of the cerebellum, before that fasciculus reaches that ganglion. According to this more simple and more elegant modification, then, the right special protective oli-versal fasciculi of the present order, will combine with the right unspecial protective oli-versal fasciculus, before this reaches the right olivary ganglion; while the right special protective mori-versal fasciculi, will combine with the right unspecial protective mori-versal fasciculus, conducting protective influence of the muscular order from the plicated layers of grey tissue of the right hemisphere of the cerebellum to the right olivary ganglion, before that fasciculus reaches the right moriform ganglion. In the cases of the right Schneiderian membrane, and the right retina, the special protective versal filaments, oli-versal and mori-versal, of the

present order, are combined together into one fasciculus with those of the following order, as far as the proximal side of the right testis. Here, however, the two genera of each order separate: the special protective oli-versal filaments of both orders, passing to the right olivary ganglion, in conjunction with the unspecial protective oli-versal fasciculus, form that fasciculus, which is well known by anatomists to pass between the right testis and right olivary ganglion. Thus the special protective oli-versal filaments from the distal organs of impression of the right side of the apparatuses of smell and of sight, conform to the law of association of special with unspecial versal filaments just delivered. The special protective mori-versal filaments, again, of both orders, from the proximal side of the right testis, forming the whole of the right pillar of the Vieussenian valve, pass to the unspecial protective mori-versal fasciculus. That pillar must therefore be regarded as entirely composed of special protective mori-versal filaments of both orders, belonging to the distal organs of impression above-mentioned. The association of the special with the unspecial protective mori-versal filaments passing from the plicated layers of grey tissue of the right hemisphere of the cerebellum to the right moriform ganglion, is thus also according to the general law. As for the grey tissue of the corpora striata and optic thalami—being guarded, by its situation, from pathological impressions from without, and therefore needing no protective muscles, it is perhaps provided, not with protective versal filaments of the muscular, but only with those of the organic order. In the right side of the apparatuses of hearing, of taste, and of touch, the case is different. Here the special protective versal filaments of the present order leave

those of the next order, a considerable space before the former generically resolve themselves into *oli-versal* and *mori-versal* filaments. The special protective versal fasciculi of the muscular order from the grey tissue of the auditory nerve in the labyrinths of the right ear, form a protective versal fasciculus, pretty well known to anatomists to leave the right auditory nerve, and associate itself with the versal portion of the right *portio dura*. As for the special protective versal filaments of the muscular order of the right side of the apparatus of touch, they may be very conveniently divided into three divisions:—first, that special protective versal fasciculus, constituting a versal part of the right *portio dura*, and which does not belong to the auditory apparatus; secondly, the protective versal portion of the unganglionated part of the right fifth nerve; thirdly, the protective versal filaments forming a part of the unganglionated fasciculi of the anterior part of the right side of the spinal cord. As the two first of these divisions are subservient to the protection of the face; so the third division is subservient to that of the rest of the body. Thus also it may be observed, that the *portio dura* of the right seventh nerve, and the unganglionated part of the right fifth nerve, composed as they are of special protective versal fasciculi and of *déal* fasciculi, appertaining to the apparatus of touch for the head, are perfectly analogous in their composition to the unganglionated fasciculi of the anterior part of the right half of the spinal cord, composed as these are of special protective versal and of *déal* fasciculi appertaining to the apparatus of touch for the whole rest of the body. Observe, again, the beautiful analogy between the modes in which the protective versal fasciculi of the *portio dura* of the right seventh

nerve, of the unganglionated part of the right fifth nerve, and of the unganglionated fasciculi of the anterior part of the right side of the spinal cord, generically resolve themselves into special protective oli-versal and mori-versal fasciculi. At the sincipital and sacral extremities of that line, where the right crus cerebelli meets the distal dextrad edge of the right crus cerebri, respectively rise the unganglionated part as well as the whole of the right fifth nerve, and the portio dura of the right seventh nerve: as Dr John Gordon observes.* Speaking of the annular protuberance, — “It is connected laterally,” says he, “to the peduncles of the *cerebellum*; and as there is no distinct natural boundary between it and these prolongations, on the anterior part, I shall consider them as separated from each other by an imaginary straight line, drawn from the forepart of the attachment of the trigeminal nerve, to the forepart of the attachment of the facial nerve of the same side.” At these two most convenient points of origin, the extremities of this line of conjunction of the right crus cerebelli with the right crus cerebri, the special protective versal fasciculi of the portio dura of the right seventh nerve, and of the unganglionated part of the right fifth nerve, generically resolve themselves into oli-versal and mori-versal fasciculi. The special protective oli-versal fasciculi, of the muscular order, merging, join themselves, according to the general law of association, to the unspecial protective oli-versal fasciculus, already described as passing from the right testis to the right olivary ganglion: the special protective mori-versal fasciculi, of the muscular order, gain the right unspecial protective

* Dr John Gordon, *loco cit.*, p. 112.

mori-versal fasciculus, and along with it the right moriform ganglion, by the right varoliad peduncle of that ganglion, commonly called the right *crus cerebelli*. In a manner precisely analogous, the special protective versal fasciculi of the muscular order, constituting a versal portion of the unganglionated fasciculi of the anterior part of the right half of the spinal cord, generically resolve themselves into oli-versal and mori-versal fasciculi, to join, respectively, according to the general law of association, the right protective oli-versal fasciculus, and the right protective mori-versal fasciculus. At the bottom of the medulla oblongata, the right special protective oli-versal fasciculus of the muscular order, trending dextrad and olivad from the median plane of the cerebro-spinal apparatus, and passing over the surface of the right olivary ganglion, gains the unspecial protective versal fasciculus, passing from the right testis to the right olivary ganglion; while the special protective mori-versal fasciculus of the muscular order, leaving its co-ordinal but disgenereous companion, and traversing the furrow of separation between the anterior and posterior parts of the right half of the spinal cord, joins the sacral peduncle of the right moriform ganglion, commonly called the right *corpus restiforme*, and so, along with this, according to the general law, associates itself with the unspecial protective versal fasciculus, passing from the plicated layers of grey tissue of the right hemisphere of the cerebellum, to the right moriform ganglion. This is transcendental anatomy derived from analogical induction. But how, it may be asked, are we assured of the truth of such transcendental anatomy? It may again be replied, By transcendental reasoning such as follows:—The unspecial and special influences subservient to the

contraction of a protective muscle are both secreted, in consequence of a material impression upon the grey tissue of that distal organ of impression of an apparatus of perceptive consciousness, to which that muscle belongs. But the influence of that impression being carried to the sympathetic ganglions of the same side, the secretion, and flow of these influences to their ultimate destination in the muscle, must be, therefore, simultaneous. In consequence, however, of their common ultimate destination, these influences must be transmitted to the same ganglion. If, therefore, it can be shewn, in a single instance, that the special protective versal filaments of the muscular order, from the grey tissue of a distal organ of impression on the right side, for example, of an apparatus of perceptive consciousness, pass to the right olivary ganglion; then, not only the unspecial protective versal filaments from the grey tissue on the convolutions of the right cerebral hemisphere, but also all the special protective versal filaments of the same order, proceeding from the grey tissue of all the distal organs of impression on the right side of the rest of the apparatuses of perceptive consciousness, must pass to the same olivary ganglion. The same reasoning holds in regard to the moriform ganglions. Now the instances alluded to may be found, it is presumed, in the versal portion of the portio dura of the right seventh nerve; in that of the unganglionated part of the right fifth nerve; and in that of the unganglionated fasciculi of the anterior part of the right side of the spinal cord. These three several protective versal fasciculi pass to the right olivary and moriform ganglions. Therefore the unspecial protective versal filaments, from the convolutions of the right cerebral hemisphere, and from the plicated layers of grey tissue in the right

hemisphere of the cerebellum, as well as the special protective versal filaments from the grey tissue of all the rest of the distal organs of impression on the right side of the cerebro-spinal apparatus, pass to the right olivary and moriform ganglions. The only exception to this great law is to be found in the optic apparatus, where the protective influence of the present order, from the right retina, passes both to the right and left olivary and moriform ganglions, in consequence of an anastomosis, at the commissure of the optic nerves, of the protective versal filaments of the muscular order ; so that the protective influence from the right retina simultaneously causes the contraction of both irides. But still, even here, the protective influence from the right retina is carried to the right olivary and moriform ganglions ; only not to them alone, as in the other cases.

82. Thirdly—by another order of filaments,—that of the protective versal filaments of the organic order, — a portion of the special influence from the grey tissue of the distal organs of impression of the apparatuses of perceptive consciousness is transmitted to the olivary and moriform ganglions of the same side, to contract the muscular fibres of the heart, the arteries, and the capillaries, and to eliminate from the contents of these latter vessels the various glandular products. In this way, not only is the organization of the tissue of such distal organs maintained in a healthy state, and the pathological effects of noxious irritants obviated, but these latter are also washed away or diluted by protective glandular products. So the eyes are protected by the tears ; the tongue by the mucous and salivary secretions ; and the organization of the head and whole body, through the instrumentality of the filaments of the present order, bound up in the

ganglionated fasciculi of the fifth pair of nerves, and in those of the posterior columns of the spinal cord ; as was finely illustrated in the patient of M. Serres, in whom the right ganglion of Gasser was completely disorganized. The same great law, of association of special with unspecial versal filaments, obtains in this order as in the preceding. The special protective oli-versal filaments of the organic order of the right side, associate themselves with the unspecial protective oli-versal fasciculus, conducting influence from the grey tissue of the convolutions of the right cerebral hemisphere, before that reaches the right olivary ganglion ; while the special protective mori-versal filaments of the organic order associate themselves with the unspecial protective mori-versal fasciculus proceeding from the pliated layers of grey tissue in the right hemisphere of the cerebellum, before that fasciculus reaches the right moriform ganglion. The special protective versal filaments of both genera of the organic order, from the right Schneiderian membrane, from the right retina, from the grey tissue of the right corpus striatum and of the right optic thalamus, continue in combination with the special protective versal filaments of both genera of the muscular order, appertaining to the right retina and right Schneiderian membrane, as far as the proximal side of the right testis. Here, however, the genus of special protective oli-versal filaments of the organic order, in conjunction with the same genus of special protective oli-versal filaments of the muscular order, and with the right unspecial protective oli-versal fasciculus, form the olivary fasciculus passing from the right testis to the right olivary ganglion ; while the genus of special protective mori-versal filaments of the organic order, in conjunction with the same genus

of special protective mori-versal filaments of the muscular order, form the right pillar of the Vieussenian valve, which, according to the general law of association, is united to the right unspecial mori-versal fasciculus before this reaches the right moriform ganglion. In the case of the auditory apparatus, the special protective versal filaments of the organic order of both genera, from the grey tissue in the right ear, continue associated in a plexiform fasciculus after the special protective versal filaments of the muscular order have left them — as far as near the encephalic mass. Here the special protective mori-versal filaments proceed along the sacrad peduncle of the right moriform ganglion, and so gain the right unspecial protective versal fasciculus, before this reaches the right moriform ganglion; while the special protective oli-versal filaments of the organic order directly seek the right unspecial protective oli-versal fasciculus passing from the right testis to the right olivary ganglion. As for the special protective versal filaments of the right side of the apparatuses of taste and of touch, they may conveniently be divided into two sets:—first, those, along with the special perceptive oli-versal filaments, composing the ganglionated fasciculus of the right fifth nerve; secondly, those, along with the special perceptive oli-versal filaments, composing the ganglionated fasciculi, whose filaments proceed from the right side of the spinal cord. The special protective versal fasciculus of the organic order of the former of these sets, generically resolves itself at the point of origin of the right fifth nerve — the oli-versal filaments merging to associate themselves, according to the general law, with the unspecial protective oli-versal fasciculus passing from the right testis to the right olivary ganglion; while the mori-versal fila-

ments, by the right varoliad peduncle of the moriform ganglion—the right crus cerebelli—gain the right unspecial protective mori-versal fasciculus before this reaches the right moriform ganglion. The special protective versal fasciculi, again, of the second of these sets, generically resolve themselves before they reach the encephalic mass of the spinal cord. The special protective oli-versal filaments of the organic order, seek the lateral fasciculus of the anterior part of the right half of the spinal cord; while the special protective mori-versal filaments, continuing to form a constituent part of the sacral peduncle of the right moriform ganglion, so reach the right unspecial mori-versal fasciculus, according to the general law. This transcendental description, especially as regards the apparatuses of taste and touch, is conformable to the best anatomical observations. The right fifth nerve is well known to arise in three fasciculi, which resolve themselves immediately into two—an unganglionated and a ganglionated fasciculus.* One of these fasciculi, composed of the protective mori-versal filaments of both orders, seeks the right moriform ganglion by the right crus cerebelli: another, composed of the protective oli-versal filaments of both orders, seeks the right olivary ganglion: the third, composed of an olidéal fasciculus of voluntary and involuntary motor filaments, and of a perceptive oli-versal fasciculus, proceeds from the left olivary ganglion. “The anterior roots” of the spinal cord, according to Bellingeri, “are composed of numerous nervous fibres, having nearly the same thickness (that of a hair), each of which arises separately—approaches the neighbouring fibres of the

* Cloquet, *loco cit.*, p. 595, art. 1527, 1529.

same root, but does not blend with them. The anterior roots, in man at least, do not enter the spinal ganglia. The posterior roots are composed of fibres arising in a triple order, the chief part coming directly from the posterior horns of the grey substance, while other filaments, few in number, take their origin from the white substance of the posterior fasciculi,—and others, again, from the lateral fasciculi. In comparing the anterior and posterior roots, four circumstances may be remarked, in which they differ. 1st, The filaments of the posterior roots are, generally speaking, thicker and less numerous than the filaments of the anterior roots. 2dly, The filaments of the posterior alone present the plexiform structure. 3dly, The posterior roots alone form the spinal ganglia. 4th, The neighbouring posterior roots almost all communicate by nervous filaments.”* It may here be worthy of observation, that from the single fact of the ganglionated fasciculi of the spinal cord sending off filaments to the sacral peduncle of the olivary ganglion, forming a part of the anterior part of the spinal cord, I became, from analogy, assured that the protective versal filaments of the organic order are, like those of the muscular order, composed of oli-versal and mori-versal filaments.

83. Thus, then, the following beautiful analogy is evident :—that while those parts of the portio dura of the right seventh nerve, and of the unganglionated part of the right fifth nerve, appertaining to the right side of the apparatus of touch, are analogous in composition to the unganglionated fasciculi of the anterior part of the right side of the spinal cord ; the ganglion-

* Johnson's Med. Chir. Review, vol. ii. p. 151, 1825.

ated fasciculus of the right fifth nerve is analogous in its composition to the ganglionated fasciculi of the right side of the same cord : and the whole of the right fifth nerve, with its dorsal fasciculus, to the nerves from the right half of the spinal cord, composed of the ganglionated and unganglionated fasciculi. Thus, also, it appears that the versal portion of the whole of the spinal cord is merely a portion of the special versal apparatus of touch, adapted to the length of the body in vertebrated animals.

84. In every apparatus of perceptive consciousness, it must be observed that these three orders of special versal filaments are combined together in a plexuose manner, for some distance, greater or less, according to circumstances, from the grey tissue of the distal organs of impression, in which they originate. Where such organ is of extensive surface, as in the apparatus of touch, the special protective versal filaments of the muscular order almost immediately leave the other two orders, passing clear of them till closely in the vicinity of the olivary and moriform ganglions of the same side ; the other two orders, however, continue combined together in a plexiform fasciculus till they nearly reach the encephalic mass. But when such distal organ is only of small superficial extent, as in the right retina, the three orders of filaments above-mentioned form together one plexuose fasciculus, as far as the commissure of the optic nerves, where the special perceptive oli-versal filaments leave the special protective versal filaments—the former to associate themselves with the unspecial protective versal fasciculus at the edge of the left crus cerebri—the latter to reach the right natis. On account of the extensive surface of the Schneiderian membranes, the olfactory apparatus contains an arrangement altogether peculiar to itself. The fila-

ments of the three several orders form themselves into a number of separate, triply compound fasciculi, which all meet together in those bulgings of the olfactory nerves which lie on each side of the *crista galli*. The three orders of filaments then continue bound up together in one fasciculus, on each side, as far as the points of union of what are called the roots of the olfactory nerves. Such bulgings are not, therefore, to be regarded as analogous to the ganglions of Gasser, which are composed only of special perceptive oli-versal filaments and special protective versal filaments of the organic order. In the case of the grey tissue of the corpora striata and optic thalami, on account of its close connexion with the unspecial versal apparatus of the olivary ganglions, the special perceptive oli-versal order of filaments immediately leave the special protective versal filaments—the former seeking the unspecial perceptive oli-versal fasciculi at the inner edges of the opposite *crura cerebri*—the latter, the unspecial protective versal fasciculi on the same side, as these have divaricated into the *tæniæ semicirculares* and the pedicles of the pineal gland. In the case of the apparatus of taste, again, the three orders of filaments are combined together for a considerable distance from the mucous membrane of the tongue, forming what are called the lingual branches of the inferior maxillary division of the fifth pair of nerves. This latter arrangement is on account of the tongue being itself a moveable fasciculus.

85. But, to be somewhat more special ;—in the case of the right side of the olfactory apparatus, the three orders of medullary filaments, already described, together with the grey filament, are all mingled together in a plexiform manner, as far as the point which is described by anatomists as the junction of the

three roots of the right olfactory nerve. From the right Schneiderian membrane, to the bulb on the right side of the crista galli, these four orders of filaments are disgregated, on account of the considerable extent of the surface of that membrane, from which they proceed. From the bulb just mentioned, however, these four orders of filaments, which had been previously disgregated, now entirely congregate into one fasciculus, as far as the well-known place of junction of the roots before-mentioned. Here the grey filament, designated by M. Cloquet as the grey root, proceeds to join the symmetrical grey tissue, which was shewn to extend between the cerebral peduncles as far as the tuber cinereum. At the point of junction of the roots of the right olfactory nerve, the special perceptive oli-versal filaments, separating from the special protective versal filaments of both orders, form what M. Cloquet calls "the internal white root." The special perceptive oli-versal filaments, forming this root, proceed to join, according to the general law, the unspecial perceptive oli-versal fasciculus "from the anterior convolutions of the middle lobes, and from some of those near the fissure of Sylvius" * on the right side, constituting the perceptive portion of the right half of the minor division of the great re-entrant system, called that of the anterior commissure. So combined, these special perceptive oli-versal filaments from the right Schneiderian membrane, gain, by traversing the median plane of the anterior commissure, the left crus cerebri, by which, along the course already ascribed to the unspecial perceptive oli-versal fasciculus, conducting unspecial influence from the convolutions of the right

* Tiedemann, *loco cit.*, p. 222.

cerebral hemisphere, they reach the left olivary ganglion. The secondary ganglion of reinforcement for the influence conducted by this order of special versal filaments, is a part of the tuber cinereum. This anatomy is entirely in accordance with the description of the derivation of "the internal white root" given by M. Cloquet, and with what Baron Cuvier has observed upon the connexion of the olfactory nerves of animals with the anterior commissure. Speaking of this root,—“it appears,” says M. Cloquet, “to be confounded, posteriorly and inwardly, with the white substance which occupies the internal part of the fissure of Sylvius.” “The anterior commissure of the brain,” says Baron Cuvier, “is evidently united to the olfactory nerves in animals.” “In such of the mammiferous animals (in particular among the Carnivora, as the dog, and among the Ruminantia and Rodentia) as possess the olfactory nerves well developed,” says Dr Tiedemann, “the anterior commissure unites also the two enlargements of these nerves; a remark which has already been made by Cuvier.”* Therefore, in accordance with the general law of combination of special with unspecial versal filaments, as well as with comparative analogy, the special perceptive oliv-ersal fasciculus, from the right Schneiderian membrane, must in man, as well as in some of the lower animals, cross the median plane at the anterior commissure, in order to reach the unspecial perceptive oli-versal fasciculus at the inner edge of the left crus cerebri.

86. As for the special protective versal filaments of both orders, they together constitute what M. Cloquet calls “the

* Tiedemann, *loco cit.*, p. 224; see also p. 220.

external white root," which rises, he says, "from the external region of the corpus striatum." Obliquely passing over the surface of the right corpus striatum, this special protective versal fasciculus joins that portion of the right unspecial protective versal fasciculus, already described (54) as known to anatomists under the name of the right tænia semicircularis. So combined, according to the general law, the special protective versal filaments under consideration gain the right testis, the secondary ganglion of reinforcement of the protective influence of the right Schneiderian membrane, and the right corpus striatum. From the right testis, the special protective oli-versal filaments of both orders pass, by the olivary fasciculus already described, to the right olivary ganglion; while the special protective mori-versal filaments of both orders reach the right moriform ganglion by the right pillar of the Vieussenian valve. Accordingly we read, in Professor Rosenmuller's account of Dr Gall's discoveries, in the second volume of the *Edinburgh Medical Journal*, that "the olfactory nerve arises from its bundle in the spinal marrow, ascends towards the testis as its ganglion, spreads from this as a broad fibrous band outwards upon the pedunculi cerebri; winds around the under and outer part of the corpus striatum in the same manner as the optic nerve, and can, like it, be peeled off the corpus striatum."

87. The purpose of the protective influence, that passes from the Schneiderian membranes along the special protective versal filaments of the muscular order, has already been specified, in art. 81.

88. The purpose of the protective influence, that passes along the special protective versal filaments of the organic order, is to

contract the muscular fibres of the arteries and capillaries of the whole aortic system, but more especially of those of the head. The effect of this influence is well illustrated by the use of sternutatories to restore the normal state of the distended capillaries of the retinae in some cases of amaurosis, as also to remove repeated sneezing, arising from an irritable state of the capillaries of a portion of the Schneiderian membrane. It is thus that a few pinches of snuff have been found to remove obstinate sneezing,* and that what are called cephalic snuffs relieve head-ache. The protective influence of this order is transmitted, as has been shewn, first to the olivary and moriform ganglions of the same side, and then, by cerebro-décal filaments, as will afterwards be shewn, to the corresponding superior and inferior cervical sympathetic ganglions, and others, whose filaments supply the internal and external carotid and vertebral arteries, and pulmonary and celiac arteries.

89. Because, after the olfactory nerves had been cut, the Schneiderian membranes were impressible as to the consciousness of the contact of strong volatile vapours, such as ammonia; and because, when they had been isolated from the ganglions of Gasser, these membranes were unimpressible as to the smell of finer odours, M. Majendie has seemingly questioned the essentiality of the olfactory nerves to smell. The ingenious first *Monro* has very happily observed, that "the fingers, dipped in acid and several other acrid liquors, have a sensation very like to tasting;" and what hinders the Schneiderian membranes, then, having, when the olfactory nerves are cut, a precisely similar

* Johnson's Med.-Chir. Review, Oct. 1836, p. 501.

nervous endowment with the fingers, and a much softer tissue, from being impressible to strong volatile vapours? Provided with all their versal appurtenances, the membranes in question are impressible as to smell by the most delicate odours. Deprived of a portion of these appurtenances, they are not so impressible. That is all.

90. In the case of the right half of the optic apparatus, the special perceptive oli-versal filaments are bound up with the special protective versal filaments of both orders, and the grey filament, as far as the commissure of the optic nerves. Here the grey filament joins the symmetrical grey tissue. The special perceptive oli-versal fasciculus from the right retina passes the median plane of the cerebro-spinal apparatus, gains the left side of the tuber cinereum, the secondary ganglion of reinforcement of the perceptive influence, and joins, according to the general law, the unspecial perceptive oli-versal fasciculus, from the grey tissue of the convolutions of the right cerebral hemisphere. These two fasciculi, now combined, pass along the inner edge of the left crus cerebri to the left olivary ganglion, in the manner already described. This is in conformity to the law before given, of the combination of the special with the unspecial perceptive oli-versal filaments. The fact that the special perceptive oli-versal filaments, from the right retina, pass to the edge of the left crus cerebri, across the median plane of the cerebro-spinal apparatus, in the commissure of the optic nerves, is established by an observation of Dr Martinet. "Lesions of the pituitary gland, of the infundibulum, and of the grey lamella in which it terminates, by causing compression of the optic nerves at one side behind the point of decussation, may induce blindness of the

opposite eye," says this excellent pathologist. The fact of the transmission of the perceptive influence from the retinæ along the inner edges of both the crura cerebri, by a route altogether distinct from that of the protective influence, is proved by several pathological observations. There is a case quoted by Dr Mackenzie, from the Synopsis of Mr Travers on diseases of the eye, where complete blindness arose from a "circumscribed tumour compressing the left optic nerve, immediately behind the ganglion opticum," but where the "iris was active."* Here the special influence had been secreted in the retinæ, and passed as far as the commissure of the optic nerves, from which, however, along the inner edges of the crura cerebri, its course had been impeded; while to the nates the course of the protective influence had been left entirely free. On the other hand, again, the course of the influence along the special perceptive oliv-ersal fasciculi, at the inner edges of the crura cerebri, may be free, while the course of the protective influence along the protective versal filaments, by way of the nates, to the olivary and moriform ganglions, may be impeded. "I have already adverted to the occasional moveableness of the iris," says Mr Cooper, in his excellent Surgical Dictionary, "notwithstanding the insensible state of the retina. Let me next take notice of a case, which sometimes presents itself, and is quite the reverse of this last. The nerves of the iris may be paralytic, while those of sight continue unimpaired." Here is evidence, next to demonstrative, then, that the influence subservient to sight, and that subservient to the contraction of the irides, at some part of their course, pass by entirely different and

* Mackenzie, *loco cit.*, p. 777.

distinct routes. Such anatomy and physiology are not without their value in the diagnosis of the diseases of the optic apparatus. Whether sight or the contraction of the irides follows, upon the impression of light upon either retina, it shews that that retina is impressible, and capable, in some degree, of performing its secretive function. In such case, therefore, the lesion must be looked for somewhere beyond the point of separation of the special perceptive oli-versal and special protective versal filaments—that is, somewhere beyond the commissure of the optic nerves. This is a fact highly worthy of attention in the treatment of amaurosis. Why waste useless therapeutical means to restore the secretive function of a retina that is perfectly impressible, but where, by pressure or disorganization, the influence it secretes to cause vision is interrupted in its progress to the organ of consciousness?

91. M. Brachet, indeed, informs us, that “M. Flourens found, after new experiments, that the section of the tubercles, (the tubercula quadrigemina,) in paralysing vision, paralyses also the movements of the pupil.” But it is submitted whether more lesion was not here inflicted than was necessary. The whole unspecial protective influence, arising from the grey tissue of the convolutions of the brain, subservient to the organic functions of the déal filaments of the arteries and capillaries, was, by the operation of M. Flourens, interrupted in its progress. Properly, the protective versal filaments only, of the optic apparatus on both sides, as they obliquely cross the cerebral peduncles, should have been divided. In that case, this apparatus would have been deprived of the function of such filaments only, without the destruction of other important parts. I must confess that I have

little or no confidence in the results attempted to be established from such reckless, uncogitated, and slashing experiments, whether performed by my own countrymen, or by our highly esteemed fellow-labourers on the other side of the channel, until these results have been confirmed by pathological observations. When Dr Martinet informs us, that "contraction, immobility, constant oscillation of the pupil at one side, indicate usually an alteration of the corpora quadrigemina of the opposite side," he says nothing of blindness being the effect of such lesion. Wherefore did Mr Travers's patient not see, if the influence subservient to sight passed by way of the nates to the organ of consciousness? There was no obstruction to the influence in that direction, as was manifest by the contraction of both irides on the impression of light upon either retina. The tumor did not press upon the filaments which obliquely cross the cerebral peduncles. But if the secretive function of the retinæ be established by their impressibility as to sight; and their impressibility as to contraction of the irides be abolished by lesion or destruction, found after death in the protective versal filaments of the muscular order in any part of their course, then it is demonstrated that the influence subservient to sight does not pass by the nates at all, but in the course assigned to it, according to a general law, applying to all the apparatuses of perceptive consciousness. The protective and perceptive influences are both simultaneously secreted from the same impression of light upon the retina.

92. The protective versal filaments of the muscular order, from the right retina, anastomose with those from the left retina, it is presumed, in the centre of the commissure of the optic nerves. The consequence of such an arrangement is, that the protective

influence from the right retina simultaneously passes to both nates, the secondary ganglions of reinforcement for the protective influence belonging to the optic apparatus. From the right and left nates, again, the protective influence from the right retina simultancously passes to the olivary and moriform ganglions on both sides, by the right and left pillars of the Vieussensian valve, and the right and left protective versal fasciculi, passing, as has already been described, from the right and left testes, to the right and left olivary ganglions. This is evidently one exception to the general law, of the special protective influence passing from the distal organs of impression of the apparatuses of perceptive consciousness to the olivary and moriform ganglions, only on the same side. Thus, then, the protective influence of the muscular order, from either retina, passes to the primary cerebro-spinal ganglions of both sides. Accordingly, when the light impresses only the right retina, for example, both irides contract. But the protective influence from the right natis contracts the left iris; that from the left natis the right iris,—as appears from the above-mentioned observation of Dr Martinet. This will be satisfactorily explained when we come to treat of the déal apparatus of the olivary and moriform ganglions, and speak of the third pair of nerves.

93. Such general anatomy is not only in perfect accordance with the general laws of combination of the special perceptive oli-versal and special protective versal filaments, respectively with the unspecial perceptive oli-versal and protective versal filaments, but also enables us to give a satisfactory explanation of some phenomena well known to those conversant with diseases of the eyes. “There are two facts regarding the motions of the

pupil in amaurotic cases," says Dr Mackenzie, " which have attracted much attention. The first is, that the pupil of a completely amaurotic eye will often move briskly, according to the degree of light acting on the opposite or sound eye, while, if we expose the amaurotic eye by itself, its pupil remains perfectly motionless, and much dilated. The second fact, and one accounted still more extraordinary, is, that in some cases, where the patient is totally blind, both pupils, according to the intensity of light to which the eyes are exposed, vary in diameter exactly as in health."

94. The special protective versal filaments of the organic order, however, from the right retina, do not anastomose with those from the left. It is a general law of the protective versal filaments of this order, without an exception, that they conduct their influence only to the olivary and moriform ganglions on the same side as that in which they arise from the grey tissue of the special organ of impression of an apparatus of perceptive consciousness. Accordingly, the protective versal filaments of the organic order from the right retina, keeping to the outside and clear of the median line of the commissure of the optic nerves, obliquely cross over the right crus cerebri to gain the right natis. From this secondary ganglion of reinforcement of the muscular as well as the organic protective influence, the protective versal fasciculus divaricates into the right pillar of the Vieussenian valve, and the fasciculus passing from the right testis to the right olivary ganglion. Thus the protective influence of the organic order from the right retina passes to the right olivary and moriform ganglions, and *vice versa*.

95. Physiological and pathological phenomena, as well as the

latest anatomical observations, are in accordance with these views. It has already been observed that the special protective versal filaments from the retinæ and Schneiderian membranes, together with those proceeding from the grey tissue of the corpora striata and optic thalami, are the only special protective versal filaments which go to compose the right and left pillars of the Vieussenian valve, and the right and left olivary fasciculi, passing respectively from the right and left testes to the right and left moriform and olivary ganglions. Now it is found, that when the only organs of impression subjected to external stimulants—viz. the Schneiderian membranes and the retinæ—are pathologically irritated, the former by sternutatories, the latter by the direct light of the sun, the same phenomenon, sneezing, takes place. It is also by the close connexion of the protective versal filaments of the organic order of the olfactory and optic apparatuses that the tonic contractility of the arteries and capillaries of the Schneiderian membranes and retinæ are equally benefited by moderate and physiological stimuli upon either of these pairs of distal organs of impression. Hence we find, that seclusion from light is not the proper way to restore the capillaries of the retina to their normal condition, after their inflammation has been removed.

96. “ Vicq-d’Azyr had found, on examining with a microscope, a horizontal section of the optic nerves of the human subject, after it had been hardened by immersion in alcohol, that the medullary fibres, occupying the exterior side of the optic nerves, proceed in a direct manner from the optic thalamus to the eye of the same side ; and that the place of union presents an homogeneous tissue. The Wenzels came nearly to a similar conclusion from their observations, but remarked, in addition, that while

the fibres of the exterior side of the nerve go immediately to the eye of the same side, those fibres, placed in its interior side, are directed obliquely towards the other nerve, without, however, any crossing of fibres being manifest at the point where the junction of both nerves takes place. M. Treviranus has, in a great measure, confirmed these observations on the male *simia aygula*. The nerves and brain were left during some months in alcohol, and afterwards kept some time in caustic potash, to soften them. Having thus prepared them, he submitted them to a careful dissection, when he made out, with the aid of a microscope, that the external fibres of the upper side of each were continued from their cerebral extremity to that in the eye, without uniting themselves to those of the other side; whilst, on the contrary, the internal and inferior fibres of one nerve went to the other side, and united with the fibres of the opposite nerve. It was difficult to determine whether any of the fibres actually passed from one side to the other. He thought, however, that some of the fibres did so. The internal fibres, thus interlacing together, were evidently more numerous than the external fibres which ran to the eye without uniting with those of the opposite nerve."* I would submit to the future observations of anatomists, whether the transition of the special perceptive oliv-ersal filaments to the opposite crus cerebri, may not be, in some measure, hidden by their entrance into the tuber cinereum, the secondary ganglion of reinforcement of the perceptive influence for the optic apparatus; and whether the filaments on the internal side, described by the Wenzels as obliquely directed towards each other, "without,

* Johnson's Med.-Chir. Review, July 1825, p. 203.

however, any crossing," are not the special protective versal filaments of the muscular order from both retinae, anastomosing together according to the views already laid down.

97. The protective d  al portion of the optic apparatus properly comes to be considered in a future part of this work, under the induction of the d  al apparatus of the olivary and moriform ganglions. * It may be worth while here to state, however, that the orbiculares palpebrarum muscles are not contractile from the influence secreted in the retinae. These muscles properly belong to the apparatus of touch, and are physiologically and pathologically contracted from irritation of the eyelids alone, but not from that merely of the conjunctiva. The sudden contraction of those muscles in winking on the approach of a threatening body, again, arises from an impression of the spirit consequent upon a previous perception of the threatening body. I have seen an instance, in a young child, where the retinae were both delicately impressible as to the motions of the irides, yet where there was no winking when the hand was darted at the face. The blindness was imputed by the child's mother to an injury of the brain from compression at delivery, and the cause no doubt acted, posteriorly to the commissure of the optic nerves, upon the perceptive versal fasciculi of the optic apparatus. The only other protective d  al fasciculi of the optic apparatus, besides the third pair of nerves, are those of the fourth pair. These are unique in their character as d  al fasciculi; they arise not from a primary, but a secondary ganglion of the cerebro-spinal system; and it is remarkable that they are instrumental in affording protection to the eyes, by relaxation of their office in contracting the superior oblique muscles. As soon as the light is excluded from the r  ti-

næ, and the nates are no longer stimulated by protective influence thence arising, these muscles being relaxed, the inferior oblique and inferior recti muscles predominating, as will be shewn afterwards, turn the corneæ upwards and backwards.

98. In the apparatuses of taste and of touch, the three orders of special versal medullary filaments, conducting influence from the right side of the tongue, and from the skin of the right side of the body, continue combined in a plexuose fasciculus, only for a very short distance from those distal organs of impression. The special protective versal filaments of the muscular order, almost immediately foregoing the plexuose, and assuming the parallel disposition, leave the other two orders of filaments. The only exception to this, is in the cases of the lingual and inferior dental branches of the inferior maxillary division of the right fifth nerve;—the former distributed to a moveable organ—the latter entering a bony canal. In consequence of this distribution, it is evident that the special protective versal filaments of the muscular order, in the cases just noticed, continue combined in a plexuose fasciculus along with the other two orders longer than would otherwise have been the case.

99. The function of the special protective versal filaments of the muscular order of the right side of the apparatuses of taste and of touch, is to conduct influence from the right side of the tongue, and the skin of the right side of the body, to the right olivary and moriform ganglions, to contract certain muscles protective of these organs of impression from noxious agents. These muscles afford protection, either by removing the offending body, or by shutting in the suffering organ. This order may most conveniently be considered, in its anatomy and physiology, in

three divisions : 1st, the versal portion of the portio dura of the right seventh nerve ; 2d, the versal portion of the unganglionated part of the right fifth nerve ; 3d, the versal portions of the unganglionated fasciculi, from the anterior part of the right side of the spinal cord, and of that part of the cord itself. A very good illustration of the effect of the influence conducted by the first division, is to be found in the contraction of the right orbicularis muscle from irritation of the lids of the right eye. This division is not distributed upon the conjunctiva. Accordingly, this membrane may be touched with a probe without winking. This follows only upon irritation of the eyelids themselves ; and there is every reason to suppose that involuntary physiological winking arises from the remora of the tears in the ducts of the lids, and not from irritation of the conjunctiva. I have dug out, with the point of a lancet, a piece of iron embedded in the cornea, the individual himself holding his eyelids open all the while. In fact, deprived of the distribution of the protective versal filaments of the portio dura of the seventh pair, the conjunctiva is utterly destitute of an apparatus for conducting influence to the primary cerebro-spinal ganglions, by which the larger muscles are contracted. The fasciculi of the ganglions of Gasser, and their congeners on the spinal cord, though impressible, when mechanically irritated, as to consciousness of pain, and contraction of the muscular fibres of the arterics of the face and glandular secretions, are yet altogether unimpressible as to the contraction of the larger muscles. “ When the proper ophthalmic branch is irritated in an animal newly killed, the muscles of the eye, as Mr Bell found, are not thrown into contraction (p. 346) ; but when it is divided, (in common with other branches of the

fifth,) the eyeball and eyelids lose their sensibility so entirely, that, according to Majendie, they are not affected even by strong ammonia ; while, at the same time, their motions continue uninjured." * It is a conclusion of Muller's, " that the dorsal or posterior roots of the spinal nerves have no vis motoria, but that the anterior have." In the patient of M. Serres, whose right conjunctiva was isolated from the corresponding ganglion of Gasser, and unimpressible as to touch from the contact of a probe, we are not told that physiological involuntary winking was impaired.† Voluntary winking, arising from an impression of the spirit consequent on its consciousness of pain in the conjunctiva, as from the sight of a threatening object, is quite a different thing from involuntary winking, arising from the removal of the tears in the ducts of the eyelids. In this latter case, there is no consciousness and consequent selective impression on the part of the spirit, interposed between the irritation, and the contraction of the muscle arising from it.

100. A beautiful illustration of the function of the second division of the protective versal filaments of the muscular order above mentioned, is to be found in mastication. Mr Mayo, it seems, has observed that the unganglionated part of the right fifth nerve is entirely expended upon the masseter, temporal, pterygoid, and circumflexus palati muscles of the right side. With submission, however, it is proposed to contend, that the unganglionated part of the right fifth nerve is composed, not only of a *déal fasciculus*, conducting influence distad to contract the muscles which ele-

* Edin. Med. Journal, vol. xxii. p. 122.

† Guthrie, Johnson's Med.-Chir. Review, Sept. 1823, p. 428.

vate and depress and turn to the left side the lower jaw, but also of a special protective versal fasciculus, conducting influence proximad to the right olivary and moriform ganglions, subservient to the contraction, not only of such muscles, but also of those which move the tongue to the right side from the impression of the alimentary mass upon the right side of that organ, and the teeth of the right side of the lower jaw. Accordingly M. Cloquet informs us, (1531,) that the unganglionated fasciculus of the right fifth nerve, having passed clear of the right ganglion of Gasser, associates itself, not with the whole fasciculus proceeding from that ganglion, after the manner of the unganglionated and ganglionated fasciculi of the right side of the spinal cord, but only with that division of the fasciculi of the right ganglion of Gasser which goes under the name of the inferior maxillary division of the right fifth nerve:—"As to the first fasciculus," says he, "formed by the five or six whiter filaments, it does not run into the ganglion, but passes clearly below it, and goes to join the inferior maxillary nerve." The protective versal fasciculus of the muscular order, corresponding to the other two divisions of the fasciculi of that ganglion, is that portion of the protective versal fasciculus of the portio dura of the right seventh nerve which properly belongs to the apparatus of touch. But what is remarkable, and confirmatory of the present views, is, that the inferior maxillary division of the fasciculi of the right ganglion of Gasser, in some instances, avails itself of the protective versal office of the special protective versal fasciculus of the portio dura of the right seventh nerve. This happens in the case of the right auricular or superficial temporal branch of the inferior maxillary nerve, distributed upon the more external parts of the right ear,

and upon the integuments of the right side of the head, whose filaments frequently anastomose with the portio dura of the right seventh nerve (Cloquet, 1554): also in the case of the right inferior dental branch of the inferior maxillary, which, escaping out of the right foramen menti, is distributed upon the skin of the right side of the lower lip, and parts in its immediate vicinity. Hence it appears, that when a portion of the inferior maxillary division of the fasciculi of the right ganglion of Gasser is distributed upon a part, requiring for its protection the muscles supplied by the dental portion of the portio dura of the right seventh nerve, the filaments of that portion of such division of such fasciculi anastomose in the proximity of the distal organ of touch, with the filaments of the special protective versal fasciculus of the portio dura of the right seventh nerve, instead of with the filaments of the special protective versal fasciculus of the unganglionated part of the right fifth nerve, whose dental fasciculus is entirely devoted to the muscles which move the lower jaw. In what way, it may be asked, do the dental filaments of the portio dura of the seventh pair of nerves protect the skin of the face? Let a blue-bottle creep over the skin of the outside of the mouth and of the cheek, and it will soon be seen what rest he shall have for the soles of his feet: every muscle will be up in arms to get rid of the troublesome visitant. As the Irish attendant said of the late Right Honourable Brinsley Sheridan's sitting covey of partridges — they will make him leave that, however.

101. Now, for the sake of illustration, the special protective versal filaments of the muscular order of the unganglionated fasciculus of the right fifth nerve, may conveniently be divided into three sets, distributed upon three several localities of impression,

and conducting protective influence from thence to be subservient to the contraction of three several sets of muscles : 1st, The set conducting influence from the mucous membrane of the inside of the right cheek to the right olivary and moriform ganglions, by which the right masseter, temporal, pterygoideus internus and externus muscles are contracted, by which the jaw is elevated and turned to the left side : 2d, The set conducting influence partly from the mucous membrane of the right side of the tongue, and partly from the roots of the teeth of the right side of the lower jaw, to the right olivary and moriform ganglion, by which the left hypo-glossal nerve contracts the left genio-glossus muscle, and turns the tongue to the right side : 3d, The set conducting influence from the roots of the teeth of the right side of the lower jaw, to the right olivary and moriform ganglions, by which not only three muscles—viz. the mylo-hyoideus, the genio-hyoideus, and the digastric muscles—are contracted, which depress the lower jaw, when the os hyoides is fixed, but also the very muscles—the sterno-hyoideus and omo-plato-hyoideus—supplied by the hypo-glossal nerves, which fix that bone.* The anatomical distribution of the inferior maxillary division of the right fifth nerve is accordant with these views. The right inferior dental branch, before it enters its foramen in the lower jaw, sends not only a déal fasciculus, it is presumed, to those three depressor muscles of the jaw just mentioned,† but also a special protective versal fasciculus, to join that of the lingual branch of the right inferior maxillary. ‡

* M. Cloquet, *loco cit.*, art. 1606.

† Ibidem, art. 1553.

‡ Ibidem, art. 1552.

102. Thus, when the alimentary mass rests upon the mucous membrane of the inside of the right cheek, the muscles on the right side which elevate the lower jaw, and give it a horizontal movement to the left, are contracted to triturate the food. But when the impression of the alimentary mass, upon the teeth of the right side of the lower jaw, becomes somewhat considerable, the lower jaw is again depressed, and the tongue, turned to the right side, is employed in casting the mass to the other side of the mouth, there to undergo a similar subaction. It is evident, then, that the special protective versal filaments of the muscular order, of the second division, conduct influence proximad, by which the muscles are contracted that move the lower jaw upwards and downwards, and horizontally to the left side, and the tongue to the right side. There may be some difficulty in conceiving the mode of conveyance of the influence from the special protective versal filaments into the déal fasciculi distributed upon these muscles. This will be sufficiently explained, however, when we come to treat of the déal apparatus of the olivary and moriform ganglions.

103. The function of the third division of the special protective versal filaments above mentioned, belongs to the apparatus of touch for the right side of the trunk, and right thoracic and abdominal extremities. This division of the order conducts influence from the skin of these parts of the body to the olivary and moriform ganglions of the same side, by which certain muscles are contracted, that withdraw the skin from the noxious irritant. These muscles are extensors; and their protective office is very well illustrated, when the hand, for example, is involuntarily drawn back from contact with a hot body. In general, it may

be briefly observed, that the action of the protective muscles of the apparatus of touch, is determined by the straight-forward direction in which we commonly move, and in which we throw forwards our upper extremities.

104. It is not peculiar to any of these divisions, but common to all of them, to conduct protective influence, by which the inspiratory muscles of the right side, more especially the right sterno-mastoid and right trapezius muscles, are contracted, the effect of which has already been described in art. 81, and need not here again be adverted to.

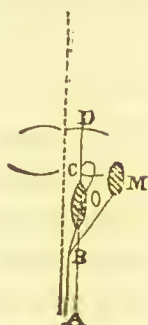
105. It will, no doubt, be asked how we shall prove the existence of special protective versal filaments in the portio dura of the right seventh nerve, in the unganglionated portion of the right fifth nerve, and in the unganglionated fasciculi of the right side of the spinal cord, or shew that these fasciculi are different in composition from purely motor nerves, as they are called? Not, certainly, by simple mechanical irritation of such fasciculi entire; for every motor fasciculus is impressible as to the contraction of the muscles upon which it terminates. Not, certainly, by dividing such compound fasciculi, and irritating the distal extremity of the versal portion of the proximal segment; for even if this were impressible as to the contraction of the muscles upon which its neighbouring déal fasciculus is distributed, such impressibility can no longer be manifested. The course of influence, indeed, if a grey nervous cord were present to generate any, is free to the primary cerebro-spinal ganglions of the same side; but the déal filaments, that should have conducted influence from these centres to the muscles in question, are entirely cut off. What, then, is to be done? How shall we separate

the versal from the d  al portion, for example, of the right portio dura, in order to irritate the former, and leave the latter entire, to manifest the contractile effect of such irritation upon the right olivary and moriform ganglions? Such an experiment were difficult of performance. But there is another sort of knife than that of the mere experimenter. There is the scalpel of logic. In M. Serres' patient, where the right conjunctiva and eyelids were altogether isolated from the right ganglion of Gasser; or when we are told by the distinguished physiologist, M. Majendie, that when the ophthalmic branch " (in common with other branches of the fifth) is divided, the eyeball and eyelids lose their sensibility so entirely, that they are not affected even by strong ammonia, while, at the same time, their motions continue uninjured;"—it may be asked, by what channel the nervous influence, in these cases, was conducted proximad, by which the orbiculares muscles were involuntarily contracted? If the portio dura of the right seventh nerve were purely d  al, how comes it that its filaments anastomose in the skin, not only with the filaments of the ophthalmic and superior maxillary divisions, but also with those of the inferior maxillary division of the fasciculi of the right ganglion of Gasser? Certainly purely motor d  al filaments have no such anatomical appointments as these. If the portio dura of the right seventh nerve be a purely d  al fasciculus,—why should it be joined by a fasciculus from the right auditory nerve? Sure such an ordination can never be observed in a purely muscular fasciculus. Not one instance can be adduced of nervous influence passing to the grey tissue of a distal organ of impression of an apparatus of perceptive consciousness, at least along a cerebro-d  al filament, unless such filament

form a part of the nervous plexus of an artery of such tissue. If the portio dura of the right seventh nerve, and the unganglionated portion of the right fifth nerve, be altogether dēal,—whence is it that their points of emergence from the encephalic mass are unanalogous to those of fasciculi distributed to muscles alone? Anatomists cannot and do not deny the distribution of the former of these nerves to the integuments of the face and head; but seem not to be equally aware of that of the latter. But as certainly as the involuntary contraction of the orbiculares muscles of the eyes is effected from irritation of the eyelids through the instrumentality of the versal and dēal portions of the portio dura of the seventh pair of nerves, so certainly do the impressions of the alimentary mass upon the mucous membrane of the inside of the cheeks and teeth of the lower jaw, through the instrumentality of the versal and dēal portions of the unganglionated portions of the fifth pair, effect the involuntary contraction of the buccinator muscles, and of those which elevate and depress, and turn horizontally to a side, the lower jaw. The more special illustration of the transeendental anatomy of this order of protective versal filaments, as given in art. 81, must be deferred till a future occasion. In the meantime, the reader may consult the best writers on the anatomy of the encephalon and the cerebro-spinal nerves. He will find some observations to his purpose in the work of Mr Solly, especially regarding the generic divarication of the fasciculi of the third division. This divarication may, however, be rendered somewhat more clearly intelligible by the following diagram.—

106. Let o be the right olivary, and M the right moriform ganglion; DC the right unspecial protective versal fasciculus,

passing from the right testis to the right olivary ganglion. Let the central dotted line represent the median plane of the cerebro-spinal apparatus ; the dotted line to the right of that, the furrow between the anterior and posterior columns of the right side of the spinal cord. Let AB be a special protective versal fasciculus of the muscular order, composing a portion of the anterior column of the right side of the spinal cord, before that fasciculus has generically divaricated into the two oli-versal and mori-versal filaments of which it is made up.



Then BOC may diagrammatically represent the special protective oli-versal filament, trending dextrad from the median plane, and passing over the surface of the right olivary ganglion O, to be inflected towards the unspecial protective oli-versal fasciculus DC, with which it associates according to the general law. The line BM, again, may represent the special protective mori-versal filament, trending also dextrad, and crossing the furrow between the anterior and posterior columns of the right side of the spinal cord, to gain the sacral peduncle of the right moriform ganglion or right corpus restiforme, in connexion with which it reaches the unspecial protective mori-versal fasciculus, passing from the plicated layers of grey tissue of the right hemisphere of the cerebellum to the right moriform ganglion—according to the general law of association. “The olivary eminences,” says M. Cloquet (1423), “emit from their superior part a fibrous fasciculus, which is joined to some other fibrous fasciculi proceeding from the sides of the spinal marrow, and which ascend, like those

of the anterior pyramids, across the fibres of the anterior face of the cerebral protuberance."*

107. The next in order to be considered, in the right side of the apparatuses of taste and of touch, are the special protective versal filaments of the organic order. The function of this order of filaments is, to conduct influence arising from pathological impressions upon the mucous membrane of the right side of the tongue, and of the skin of the right side of the whole body, to the olivary and moriform ganglions of the same side, in order that déal filaments arising from these nervous centres may conduct influence to be subservient to the contraction of the muscular fibres of the heart, arteries, and capillaries, and to the elimination of the various glandular products, from these latter vessels, to obviate by such means the bad effects of noxious agents upon the organization of the tissues of the distal organs of impression on the right side of the apparatuses of perceptive consciousness in question. This order of versal filaments may very conveniently be divided into two sets: 1st, Those which, along with the special perceptive oli-versal filaments belonging to the mucous membrane of the right side of the tongue and the skin of the right side of the face and head, constitute the ganglionated fasciculus of the right fifth nerve: 2d, Those which, along with the special perceptive oli-versal filaments distributed upon the skin of the right side of the trunk and right thoracic and abdominal extremities, constitute the ganglionated fasciculi from the right side of the spinal cord. The function of the former of these two sets of special protective versal filaments, and

* See also Dr Tiedemann, *loco cit.*, pl. xiv. fig. 1.

therefore, by analogy, that also of the second set, has been beautifully illustrated and proved by that remarkable pathological observation, for which we are all so much indebted to M. Serres, the distinguished author of the Comparative Anatomy of the Human Brain. In this very important case, the right ganglion of Gasser, as it is called, as well as the filaments which enter it, were entirely disorganised ; affording an isolation of the mucous membrane of the right side of the tongue and the skin of the right side of the head, from two out of the three orders of special versal filaments of the apparatuses of taste and touch, without any further lesions to complicate the result. M. Majendie will find, that the fasciculi of the ganglion of Gasser, so far from being the nerves of smell, are really not absolutely essential to the impressibility of the skin as to touch. M. Serres' patient was sensible of the contact of a probe upon his right cheek. This, as has already been explained, was owing to the nature of the nervous plexus of the external carotid artery, which, besides the filaments of the superior cervical ganglion of Gasser, receives filaments from the pneumo-gastric and facial nerves. But it may be asked, Why, then, should the right side of the tongue have been unimpressible as to the taste of pepper, and the right nostril so as to the smell of snuff, ammonia, &c., since the plexuses of the arteries of these mucous membranes are of the same composition as those of the arteries of the cheek? It is probable that the consciousness of taste and of smell requires a greater perfection in the secretive function of the distal organs of impression than the consciousness of touch. The conjunctiva, in this case, deprived of every nervous endowment but that from the superior cervical ganglion, was in the same state of unimpressibility as

to touch as the brain itself. It gave no token of the contact of a probe. But towards the close of this case, so utterly were the circulatory, and, therefore, the secretory, powers of the capillaries supplied by the filaments of the superior and inferior cervical ganglions impaired, that these vessels were wholly inadequate to their more delicate functions. The right retina was unimpressible as to sight, and the right auditory nerve as to hearing. The gums on the right side were scorbutic; and the man had epileptic fits. The right side of the tongue was also unimpressible as to the secretion of the saliva from the contact of pepper. From all these facts, then, it is evident that there are filaments in the fasciculi of the ganglion of Gasser, whose function it is to conduct influence from the skin of the right side of the head, to contract the muscular fibres of the arteries of the right hemisphere of the brain and the right side of the head, to eliminate the saliva from the right salivary glands, and, in short, to carry on the nutritive as well as other functions of the organs supplied by the right internal and external carotid arterics.

108. Similar effects, it is said, have arisen from such isolation artificially accomplished by M. Majendie. It has been seen, that when the conjunctiva was isolated from the right ganglion of Gasser, it was found to be unimpressible as to the secretion of tears from the irritation of ammonia; and, had no better observation been to be had in proof of the distinct existence of the present order of versal filaments, I should have inducted even from that; but my confidence in the truth of the results, attempted to be established from experiments, when so much injury is inflicted besides that merely necessary for effecting the isolation contemplated, is very much shaken; and on every occasion, co-

æris paribus, pathological observations have been preferred, when they could be had, for the induction of the laws in this work. But in studying the pathological results of every such experiment, whether performed by nature or by art, we must contemplate, not only the deprivation of the nervous centres supplying the arteries of the distal organs of impression of the apparatuses of perceptive consciousness of so much nervous influence transmitted to them, but also the morbid and virulent nature of the poisonous aura secreted by the irritable grey tissue of the injured fasciculi of the ganglion of Gasser, constantly flowing into the primary cerebro-spinal and sympathetic ganglions. It is the transmission of such morbid aura, it is presumed, which causes so much perturbation in the functions of the capillaries of the internal carotid and external carotid and vertebral arteries, as to render the tissues of the distal organs of impression unimpressible as to the more delicate modifications of matter, such as light, and air, and odours, though they still may remain so by matter in a solid form. It is very well known to every pathologist how often irritation of the fasciculi of the ganglions of Gasser, in any one of their three great divisions, causes loss of sight, loss of hearing, and loss of smell. The terrible effects of such morbidly secreted aura in disordering the functions of the sympathetic ganglions, seems not sufficiently to have attracted the attention of pathologists. Witness traumatic tetanus. A man may walk for some time immediately after the division of a great number of the filaments of the superior cervical ganglions distributed in plexuses upon the arteries of the brain, as we have seen in the case of the French soldiers; but when once the extremities of such filaments take on a diseased action, as in

cases of ramollissement of the brain, the secretive function of these ganglions is so much impaired, that a sufficient quantity of influence, unspecial and special, cannot be generated for voluntary muscular contraction, and palsy necessarily follows. Pathologists are too apt to discourse as if the grey versal unfilamentous appurtenances of the sympathetic ganglions had no existence in tissues, and to overlook the morbid effects of the irritation or lesion of such appurtenances upon the secretive functions of these ganglions, independently of all consciousness of pain.

109. Perhaps it may be asked, how shall we attempt to prove the existence of this order of special protective versal filaments of the organic order, in the ganglionated fasciculi of Gasser, and in those of the spinal cord, independently of the special perceptive oli-versal filaments, the next order to be described, with which they are associated in such fasciculi. The only reply I shall make at present is somewhat transcendental. I would ask, of what are the sacral peduncles of the moriform ganglions composed, before they are joined by the fasciculi from the unganglionated fasciculi of the spinal cord? I would also ask, what is the function of the filaments, which, according to Bellingeri, proceed from the ganglionated fasciculi to join the lateral columns of the spinal cord? It is quite certain that neither of these two orders of filaments are the special perceptive oli-versal filaments, which, as will soon be shewn, are more profoundly derived. I would also ask, why, on the isolation of the tissues of the right side of the face and head from the right ganglion of Gasser, are not the consciousness of touch and that of taste, respectively on the right conjunctiva and on the right side of the tongue, the

only phenomena annulled? why does disorganization of the whole right side of the head, unimpressibility of the conjunctiva as to secretion of tears from the irritation of ammonia, &c., that of the right side of the tongue as to the secretion of the corresponding salivary glands, also follow? I would also ask, if the filaments of the fasciculi of the ganglion of Gasser are of the same function, why, contrary to all analogy, are they mingled together in a plexuose manner?

110. The order of special perceptive oli-versal filaments conducting influence from the right side of the tongue, and the skin of the right side of the whole body, to be subservient to the consciousness of taste and of touch, come next under consideration. They, of course, conveniently admit of a division similar to that of the former: 1st, into that set forming part of the ganglionated fasciculus of the right fifth nerve; 2d, that set composing portions of the ganglionated fasciculi of the right side of the spinal cord. The present order communicates to each of these divisions of fasciculi, impressibility as to pain from mechanical irritation. Such impressibility is due to the nervous cord of grey tissue, which is prolonged upon these fasciculi to the distal organs of impression on the right side of the two apparatuses in question, from the symmetrically disposed grey tissue of the cerebro-spinal system of nerves.

111. In laying down the transcendental anatomy of the special versal apparatuses of perceptive consciousness, I had occasion to state, that the special perceptive oli-versal filaments from the mucous membrane of the right side of the tongue, from the skin of the whole of the right side of the body, and from the grey tissue of the auditory nerve in the labyrinths of the right ear,

together form the superficial filaments of the right side of the pons Varolii, as they pass obliquely, from the right side of the anterior floor of the fourth ventricle, to gain, according to the general law of combination (80), the unspecial perceptive olivary fasciculus on the inner edge of the left crus cerebri, before that fasciculus reaches the left olivary ganglion. The present order of filaments from these several distal organs of impression on the right side just mentioned, may therefore very conveniently be studied together. Before they reach their ultimate destination, they unite into one fasciculus, merging on the right side of the median line of the pons Varolii, and traversing the median septum of the tuber annulare: only the special perceptive olivary fasciculus of the right Gasserian ganglion, or first division, joins the encephalon more proximad than that of the right auditory nerve, and this more proximad than that of the second division. The first of the fasciculi just mentioned, leaves the right fifth nerve at the point of its origin, described in art. 81, p. 104; the second of these fasciculi leaves the auditory nerve, as it is called — that is, the doubly compound fasciculus — at the point where it rises from the right corpus restiforme, from which point it joins the fasciculus last to be mentioned, constituting that medullary cord which lies immediately contiguous to the median plane of the cerebro-spinal system, as that plane passes through and symmetrically divides the spinal cord and the anterior floor of the fourth ventricle.

112. Such views are in accordance with anatomical descriptions and pathological observations. "The acoustic nerve," says M. Cloquet, "arises transversely from the restiform body, from the substance of a little slightly prominent grey ribbon,

which constantly covers the base of this nerve, and which unites it to the floor of the fourth ventricle. Most commonly some of its roots traverse this cord (or ribbon), and proceed manifestly to join the two superior of the white striæ which are observed on the sides of the *calamus scriptorius* (1404.)” At art. 1404, again, we have the following:—“ Lower, there is a slightly excavated surface, nearly vertical, which constitutes the anterior wall of the fourth ventricle. It is covered by a layer of grey substance, and divided, through all its length, by a narrow angular furrow, which commences at the origin of the aqueduct of Sylvius, and which terminates in the spinal cord opposite to the atlas. It is this furrow which is commonly called *Calamus scriptorius*; because, at its termination, it forms an acute angle somewhat resembling the beak of a pen. Many oblique, white, very fine lines, proceed from above downwards, and from without inwards, to pass to this groove; they seem to be a sort of little bands, lightly applied to the surface of the protuberance. Haller, Vicq-d’Azyr, and Sæmmering, regard these white little fasciculi as the origin of the acoustic nerve.” As to the connexion of the special perceptive oli-versal fasciculus from the right auditory nerve with the fasciculus of the second division of the same order, on the right side of the median plane of the fourth ventricle and spinal cord, we have the authority of Dr Tiedemann:—“ Lastly, we observe on either side,” says he, “ on the margin of the posterior longitudinal groove, or at the entry of the canal of the spinal marrow, a very thin and narrow fasciculus, formed of longitudinal fibres. In the fœtus of the fifth month, I recognised, for the first time, the presence of this fasciculus, manifest traces of which had also appeared in the spinal marrow of fœtuses

the most advanced. It contracts the fissure of the canal of the spinal marrow. On a level with the calamus scriptorius, it inclines aside and passes into the restiform fasciculus. We can also distinguish it in the adult, along the posterior longitudinal groove."* In exact conformity with this anatomy, we have the pathological testimony of Dr Martinet. "As to alterations of the transparency of the membranes and humours of the eye, and to paralysis of the organs of sense at one side, they seem to depend," says he, "either on a derangement of the ganglion of the fifth pair of nerves, where it lies on the petrous portion of the temporal bone, or a lesion of the corresponding walls of the fourth ventricle."† "M. Ollivier observes that a hæmorrhagy into the tuber annulare only paralyzes the movements; M. Cruveilhier, on the contrary, asserts that such an affection destroys the sensations and the movements, but leaves the intellect uninjured."‡ Science, here presuming to arbitrate, would decide, that of the two distinguished pathologists, the latter, though seemingly wrong in one point, is much nearer the truth than the former. Science would say, that if pressure were made upon the whole of the right side of the pons Varolii, so as to interrupt the transmission of nervous influence through every filament composing it, then, in so far as the unspecial perceptive olivary fasciculus at the inner edge of the right crus cerebri would be deprived of its conductive function, all the distal organs of impression of the apparatuses of perceptive consciousness in the left side would be unimpressible as to that effect; and that, in so far as the special perceptive oli-

* Dr Tiedemann, *loco cit.*, p. 148.

† Dr Martinet, *loco cit.*, p. 134.

‡ Johnson's Med.-Chir. Review, Oct. 1836, p. 305.

versal fasciculus, composing the transverse superficial filaments of the right side of the pons Varolii, and proceeding from the mucous membrane of the right side of the tongue, the skin of the right side of the whole body, and the grey tissue of the right auditory nerve, was deprived of its conductive function, the distal organs of impression of the right side of the apparatuses of taste, of touch, and of hearing, would be unimpressible as to perceptive consciousness : but while the unspecial perceptive oli-versal fasciculus at the inner edge of the left crus cerebri was not pressed upon, the right Schneiderian membrane, the right retina, the grey tissue of the right corpus striatum, and of the right optic thalamus, would be impressible respectively as to smell, sight, memory, and fancy. Where, however, shall we find a naturally occurring lesion exactly performing what we want, and nothing more ?

113. Of the apparatuses subservient to perceptive consciousness from the impressions of matter, the next in order to be considered is that of hearing. Of the three orders of special versal filaments proceeding from the grey tissue in the labyrinths of the right ear, two have already been considered. The more general anatomy of the special perceptive oli-versal filaments has already been adverted to in the 111th and 112th articles ; while the special protective versal filaments of the muscular order were considered in the 81st article ; so that only the special protective versal filaments of the organic order remain here to be noticed. Those from the grey tissue of the right auditory nerve in the labyrinths of the right ear, together with the special perceptive oli-versal filaments, constitute a plexuose fasciculus to within a very short distance of the encephalic mass. Describing the auditory nerve, as it is commonly called, of either side—" In proportion as

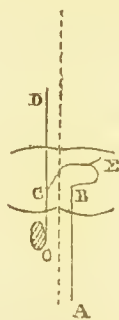
it removes from the encephalon," says M. Cloquet, "it forms a flattened cord, rolled as it were upon itself, and hollowed within by a furrow which lodges the trunk of the facial nerve. All the filaments which constitute it are very delicate, and anastomosed among themselves, so as to form a very complicated and close plexus; only behind, almost from the origin of the nerve, a whiter softer cord than the rest is to be observed, not formed of distinct filaments—(the special perceptive oli-versal fasciculus?)—which seems homogeneous and pulpy." Now, the mode of divarication of the special protective versal fasciculus, thus bound up along with the special perceptive oli-versal fasciculus, and constituting what is commonly called the right auditory nerve, is rendered much more difficult to be inducted under the general laws of resolution, into generic oli-versal and mori-versal fasciculi, and of combination with the unspecial protective oli-versal and mori-versal fasciculi, on account of the discrepancies of writers in their descriptions of the origin of the auditory nerves. "The auditory nerve arises on each side," says Dr John Gordon, "from the anterior surface of the peduncle of the cerebellum, immediately behind the origin of the facial nerve." But perhaps M. Cloquet is somewhat nearer the truth in his description of the origin of the right auditory nerve, under the twofold nature which has here been ascribed to it. Anatomists, in describing the origin of a fasciculus from the encephalic mass, should not attribute it to the ultimate point to which they have been able to trace one only of its constituent fasciculi. In describing the origin of the right auditory nerve, as from the corresponding side of the anterior floor of the fourth ventricle, this is what, I am afraid, Spurzheim has done. He has attributed, I submit, the origin of a doubly

compound fasciculus, composed of a special perceptive oli-versal and of a special protective versal fasciculus, to the point to which he has traced the former of these portions. I would also submit to the future research of anatomists, whether, while the special perceptive oli-versal fasciculus may be traced to the corresponding wall of the fourth ventricle in the manner already attempted, the point of detachment from the encephalon of what is called the whole auditory nerve, doubly constituted as has been supposed, is not at a point as convenient for the divarication of its special protective versal portion into its generic elementary oli-versal and mori-versal fasciculi, as the origins of the right portio dura and right fifth nerve:—whether it is not a point at once connected with the varoliad peduncle of the right moriform ganglion—the right crus cerebelli—and situated in the line where this is joined to the right side of the annular protuberance, and immediately above the right unspecial protective versal fasciculus, passing from the right testis to the right olivary ganglion. When anatomists have traced a fasciculus so far from the point of its detachment into the substance, and along the surface, of the encephalic mass, they should carefully observe whether the disengaged fasciculus, at its point of emergence, does not derive other filaments from some other line than that of the fasciculus in the encephalon which so prominently attracted their attention. “The seventh pair,” says the ingenious First Monro, “comes from the lateral part of the *annular process*, behind where the medullary processes of the cerebellum are joined to that *tuber*.” “The nerves of the seventh pair, termed auditorii,” says Winslow, “arise from the lateral and posterior part of the great transverse protuberance of the medulla oblongata.” Looking

also in the work so often referred to, at fig. 1, pl. ix., a copy of Dr Tiedemann's plate, the origin of the auditory nerve agrees with the descriptions here adduced of it by Drs Gordon, Monro, and Winslow. But last, not least, let us hear M. Cloquet. "The acoustic nerve," says he, "begins to separate from the substance of the encephalon in a small nearly triangular excavation, placed between the olivary eminence, the peduncle of the cerebellum, the protuberance, and the restiform body. That excavation contains also the facial nerve, which, besides its distinct origin, is likewise separated from the acoustic by a little projection of the spinal marrow, which passes between them, and by some small vessels." From the point of emergence of the right auditory nerve, then, it is presumed, that the special protective oli-versal filaments of the organic order join the right unspecial protective oli-versal fasciculus, passing from the right testis to the right olivary ganglion; while the special protective mori-versal filaments of the same order gain, by the right peduncle of the cerebellum, the unspecial protective mori-versal fasciculus proceeding from the plicated layers of grey tissue of the right hemisphere of the cerebellum to the right moriform ganglion. Should such be found to be the case, that fasciculi really pass from the point of detachment of the right auditory nerve in the directions just mentioned, it will be one among several instances occurring in the course of this work, where, by means of a general law, I have been able to predict the true anatomy of nervous filaments, which had previously been either altogether unsettled, or altogether unknown. Now Dr John Gordon informs us that a fasciculus really does pass from the point of disengagement of the right auditory nerve along the right peduncle of the cerebellum.

“ Lastly, there is a small surface of the peduncle,” says he, “ which looks directly downwards. This is bounded, before, by the surface just described; behind, by the spinal cord; on the inside, by the protuberance; and without, by the sub-peduncular lobule. It is of an oblong shape, measuring about a quarter of an inch in length, and a fifth in breadth. Two white ridges are seen on it, running from the spaces described on the former surface as giving attachment to the facial and auditory nerves, backwards and inwards.”* If the white ridge, then, which Dr Gordon says passes backwards and inwards, and towards the median plane of the cerebro-spinal apparatus, or towards the right mori-form ganglion, can really be traced to this nervous centre, we may be assured that an oli-versal fasciculus also passes from the same point of emergence of the right auditory nerve to the right unspecial protective oli-versal fasciculus.

114. Let the central dotted line represent the median plane of the cerebro-spinal apparatus; let o be the left olivary ganglion; DCO the unspecial perceptive oli-versal fasciculus, conducting unspecial perceptive influence from the grey tissue of the convolutions of the right cerebral hemisphere. Let AB represent the special perceptive oli-versal fasciculus passing immediately on the right side of the median plane, and conducting perceptive influence from the skin of the whole of the right side of the body, with the exception of the head; let the special perceptive oli-versal fasciculus of the right fifth nerve, conducting percep-



* Dr Gordon, *loco cit.*, p. 117.

tive influence from the right side of the mucous membrane of the tongue and the skin of the right side of the head, meet the fasciculus AB at E, as it is continued from the right side of the anterior wall of the fourth ventricle, obliquely across the right side of the tuber annulare. Then the line BEC may represent the mode in which the special perceptive oli-versal fasciculus of the right side of the apparatuses of taste and of touch crosses the median septum of the tuber annulare, to associate itself, according to the general law, with the unspecial perceptive oli-versal fasciculus on the edge of the left crus cerebri, before this reaches the left olivary ganglion.—For the sake of distinctness, AB and DCO are diagrammatically drawn a little further than they should be from the median dotted line.

115. Having now given a slight sketch, with a very brief illustration, of the scientific laws of the special versal parts of the apparatuses subservient to perceptive consciousness from the impressions of matter, it now remains to treat of the special versal parts of the apparatuses subservient to the same effect, and to voluntary muscular contraction, from impressions of the spirit. The distal organs of impression of these latter apparatuses are to be found, it is presumed, in the grey tissue of the corpora striata and optic thalami—the former portions of tissue being subservient as organs of impression of the spirit to the voluntary contraction of the muscles of the opposite abdominal extremities; the latter portions of tissue subservient in the same capacity to the voluntary contraction of the opposite thoracic extremities. By selective impressions upon the capillaries of this tissue, not only is the special and determined contraction of muscles effected to accomplish certain definite purposes, but the consciousness of past nia-

terial impressions is renewed, and that of new combinations of such impressions—giving rise to the phenomena of memory and fancy—is effected. Such selective impressions upon the grey tissue just mentioned, are made through the instrumentality of influence conveyed from that part of the sympathetic system of nerves in which the spirit resides, along sympa-déal filaments emanating from the superior sympathetic cervical ganglions, and forming parts of the plexuses of the internal carotid arteries, which supply the grey tissue in question. The truth of this was beautifully illustrated in the case of the insane patients of the venerable Pinel, who were made aware of the accession of a paroxysm of violence by the sensation of heat rising from the region of the semilunar ganglion to the head.

116. Now it is remarkable, that from the grey tissue of each of the distal organs of impression of the spirit on one side, three different orders of special versal filaments, as in the case of the apparatuses of perceptive consciousness from material impressions, pass to the primary cerebro-spinal ganglions. 1st, There is one order of filaments, conducting special influence subservient to the voluntary contraction of the larger muscles of the opposite side of the body. 2d, There is another order of filaments, conducting special influence subservient to the contraction of the muscular fibres of the arteries and capillaries, by which the organization of the tissue in question is protected, by the tone of these vessels being maintained in a healthy state. 3d, There is another order of filaments, conducting influence to the organ of perceptive consciousness to impress the soul, so as to cause the phenomena of memory and fancy :—comprehending among the phenomena of memory, the consciousness of the power

of contracting particular muscles to move particular members or parts of the body. The first of these orders of filaments, I would propose to denominate musculo-oli-versal filaments; they all proceed to the olivary ganglions of the same side as that of the special grey tissue in which they originate. The second of these orders of filaments I would propose to denominate special protective versal filaments of the organic order; they pass to both the olivary and moriform ganglions on the same side as that of the special grey tissue in which they originate. The third of these orders of filaments may be denominated special perceptive oli-versal filaments; they pass to the unspecial perceptive oli-versal fasciculi at the inner edges of the opposite crura cerebri, and, along with these fasciculi, to the olivary ganglions on the opposite side to that of the special grey tissue in which they originate.

117. Anatomists at all conversant with the filamentous structure of the brain are very well aware, that fibres pass from the grey tissue of the corpora striata and optic thalami on the right side, for example, to associate themselves with the unspecial musculo-oli-versal fasciculus of the fourth order already considered, (63), which conducts unspecial influence from the grey tissue of all the convolutions of the right cerebral hemisphere. Such fibres, which we have called special musculo-oli-versal filaments, present to the median plane of the cerebro-spinal apparatus a convexity, while their concavity is dextrad, as has already been represented in the cut of art. 67. Speaking of the corpora striata—"On cutting them obliquely and at different heights," says M. Cloquet, "the white and the grey substance are seen disposed in their interior in alternate stripes of various forms,

and of greater or less size. With a little care, it is perceived that all the white little bands are continuous with the primitive fasciculi of the olivary bodies." Again — wishing, no doubt, to convey a notion of the mode of formation of the optic thalami — "The olivary eminences," says M. Cloquet, "emit from their superior part a fibrous fasciculus, which is joined to some other fasciculi proceeding from the sides of the spinal cord, and which ascend, like those of the anterior pyramids, across the fibres of the anterior face of the cerebral protuberance. During this course, it is not so manifestly increased in size as the preceding, and it goes to form the posterior and internal part of the same cerebral peduncles. There it meets with a great mass of grey substance, receives new filaments from it, which follow different directions in its interior, and constitute what is called the optic thalamus." "The fibrous peduncles of the brain, the continuations of the pyramidal fasciculi, passed upwards," says Dr Tiedemann, "into the optic chambers, which were covered on their superior surface by a soft unfibrous vascular mass; they passed afterwards into the corpora striata, to which they sent fibres directly upwards, and were also covered with a similar layer of unfibrous substance."*

118. The special protective versal filaments of the organic order from the grey tissue of the right corpus striatum and right optic thalamus, immediately separating from the order just described, take a different course. Those from the grey tissue of the right corpus striatum join that one of the fasciculi of divarication of the right unspecial protective versal fasciculus conducting unspecial protective influence from the convolutions of the

* Dr Tiedemann, *loco cit.*, p. 114.

right cerebral hemisphere, which is called the right *tænia semicircularis*. In combination with this the special protective versal fasciculus gains the right testis, the secondary ganglion of reinforcement of the protective influence for the right corpus striatum and right Schneiderian membrane. Here this special protective versal fasciculus of the organic order generically resolves itself into *oli-versal* and *mori-versal* fasciculi, the special protective *oli-versal* fasciculus continuing in combination with the unspecial protective *oli-versal* fasciculus; the special protective *mori-versal* fasciculus combining with the special protective *mori-versal* fasciculus forming the right pillar of the Vieussenian valve, which joins the unspecial protective *mori-versal* fasciculus that proceeds from the plicated layers of grey tissue of the right hemisphere of the cerebellum to the right moriform ganglion:— according to the general law. As for the special protective versal filaments of the organic order from the grey tissue of the right optic thalamus, they associate themselves with that one of the fasciculi of divarication of the right unspecial protective versal fasciculus, known to anatomists under the name of the pedicle of the right side of the pineal gland. Thus associated, this special protective versal fasciculus reaches the right side of the pineal gland, the secondary ganglion of reinforcement of protective influence of the right optic thalamus. From the right side of this gland the special protective versal filaments of the organic order of the right optic thalamus gain, in the manner just described, the right olivary and moriform ganglions. The special protective versal filaments from the grey tissue of the corpora striata and optic thalami are not imaginary objects. Dr John Gordon has particularly noticed them. “The whole superior surface of

the corpora striata," says he, "seems to be covered with an extremely thin layer of yellowish-white matter, similar to that which lines the median side of the thalami optici, and like it, a little tougher than the white nervous matter in other parts of the brain. This coating is best seen in a section of the corpus striatum, for it is so fine, that the brown matter underneath obscures it very much when viewed from above."* Again—"On the side of the thalamus next the median plane," says he, "the thin covering of white matter just described, is laid over a layer about a twelfth of an inch thick of greyish-brown matter. It is this stratum, which, shining through the former, gives the whole of this surface its dark colour."† Again—"Each thalamus, however," says he, "is surrounded at all points by a coating of orange-white matter. This coating is exceedingly thin, on the side which looks towards the vertical prolongation of the central fissure; so thin indeed, that unless the brain be examined in a very recent state, it may escape notice altogether; yet it seems to me to be a good deal tougher than the white matter in other parts of the brain. On the other surfaces of the thalamus, the coating is considerably thicker, but not uniformly thick at all points; it is deepest where it forms the ridge called the peduncle of the pineal gland."‡ The fact is, that as the special protective versal filaments of the organic order from the grey tissue of the right corpus striatum and right optic thalamus obliquely converge to join, respectively, the unspecial protective versal fasciculus called

* Dr Gordon, *loco cit.*, p. 137.

† Ibidem, p. 136.

‡ Ibidem.

the right tænia semicircularis, and that called the right pedicle of the pineal gland, they must, by their closer approximation to each other, proportionally conceal the grey coating over the surface of which they pass. No doubt there is a great disparity in the sizes of the secondary ganglions of reinforcement of the grey tissue of the right corpus striatum, and that of the right optic thalamus; yet if we consider that the impetus of the nervous aura, from the grey tissue of the right corpus striatum, to produce a muscular contraction in the left abdominal extremity, must be greater than that of the nervous aura from the grey tissue of the right optic thalamus, to produce a muscular contraction in the left thoracic extremity—the former aura having to traverse a greater extent of medullary conduits—there may be some reason for the difference of the secondary ganglions of reinforcement in question, to guard the organization of the grey tissue more actively impressed by the eliminating influence sent along the sympa-déal filaments of the right superior cervical sympathetic ganglion. Notwithstanding, however, of such provision, it has been found that the arteries of the grey tissue of the corpora striata oftener give way and cause apoplexy, and consequent palsy, than those of the grey tissue of the optic thalami. This comparatively greater liability to failure in the vessels of the corpora striata may partly arise from their being much more frequently impressed in walking and running. “The most frequent seat of extravasations of blood in apoplexy, according to Morgagni, is the *corpus striatum*. This opinion has been found substantially correct by modern writers. Of twenty-eight cases examined by Rouchoux, in twenty-four the extravasation was

found in the *corpus striatum*.”* But what evidence is there, it may be asked, that the right half of the pineal gland is subservient in its function to the grey tissue of the right optic thalamus, regarding this as an organ of impression subservient to the voluntary contraction of the muscles of the left arm? When the latter of these organs is wanting, so is the former. Speaking of the optic thalami—“Fishes,” says Dr Tiedemann, “have hitherto presented nothing which could be compared to these bodies.” Again, speaking of the pineal gland—“Fishes,” says he, “are destitute of this body.”

119. The next, or third order of special versal filaments, is that which conducts influence from the grey tissue of the right corpus striatum and right optic thalamus, to be subservient to the consciousness of those selective impressions of the spirit which give rise to the phenomena of memory and fancy. In the case of the grey tissue of the right corpus striatum, the special perceptive oli-versal filaments, converging, combine with the unspecial perceptive oli-versal fasciculus, forming the perceptive portion of the right half of the division of the great re-entrant system, called that of the anterior commissure. So combined, the special perceptive oli-versal filaments from the grey tissue of the right corpus striatum traverse the median plane of the cerebro-spinal apparatus, through the medium of that commissure gain the inner edge of the left crus cerebri, and so reach, according to the general laws of transition and combination, the left olivary ganglion. This is in conformity with established anatomy. “The anterior commissure,” says Dr Tiedemann, “forms the union between

* Art. *Apoplexy*, Cyclop. of Pract. Med.

the radiations of the crura cerebri, corpora striata, and the two middle lobes of the cerebral hemispheres. Willis was the first anatomist who considered it as a commissure of the corpora striata."* Again—"This cord, situated transversely, and uniting the two hemispheres together, passed into the corpora striata, and was reflected backwards, dipping into the middle lobes of the brain. Here, it expanded into a great number of delicate fibres, which united with those coming from the crura cerebri, and ultimately passed into the corpora striata."† "The anterior commissure of the brain proper," says Dr John Gordon, "is continuous on each side with an orange-white cord, about an eighth of an inch in diameter, and an inch in length; which extends through the corpus striatum, first outwards and a little forwards, then downwards and a little outwards and backwards, and terminates in the stratum of orange-white matter which supplies the convolutions of the middle lobe, close to the inner lobule of that lobe."‡ The special perceptive olivary filaments from the grey tissue of the right optic thalamus, constitute one of those fasciculi which are well known by anatomists to pass from the optic thalami to the corpora mammillaria, and which are commonly described as being reflected from these corpora to the anterior capillaries of the fornix. But as the anatomy of these fasciculi must needs be studied in relation to the direction in which they conduct their influence—that is, to the olivary ganglions—their further course must be traced along the inner edge of the crura cerebri from those corpora to these ganglions, where fasci-

* Dr Tiedemann, *loco cit.*, p. 221.

† Ibidem, p. 200.

‡ Dr Gordon, *loco cit.*, p. 131.

euli have already been shewn to pass. In order, however, that, according to the general law of transition of special perceptive oli-versal filaments, the special perceptive oli-versal fasciculus from the right optic thalamus may pass to the left corpus mammillare, along the left crus cerebri to the left olivary ganglion, there is a special commissure, it is presumed, upon the special perceptive oli-versal fasciculi from the grey tissue of the right and left optic thalami—there being no unspecial commissure of which to take advantage in making their transit across the median plane of the cerebro-spinal apparatus. It is submitted to the future research of anatomists, whether such special commissure does not constitute the posterior commissure of the brain, which Dr Gall erroneously reckoned a part of its great re-entrant system. I say erroneously, because that system being composed entirely of unspecial versal filaments, conducting unspecial influence, no part of it can consist of special versal filaments conducting influence from the grey tissue of special organs of impression. According to this view, the corpora mammillaria must be regarded as the secondary ganglions of reinforcement of the perceptive influence of the grey tissue of the optic thalami, as organs of impression of the spirit subservient to memory and fancy, and consciousness of volition of muscular contraction—just as the two sides of the tuber cinereum are the secondary ganglions of reinforcement of the perceptive influence for the two retinae; and the commissure of the special perceptive oli-versal fasciculi, from the grey tissue of the optic thalami, will be analogous to the commissure of the optic nerves, whereby the perceptive fasciculus from the right retina passes to the left side of the tuber cinereum, and along the edge of the left crus cerebri to the left olivary

ganglion. If there be no commissure between the corpora mammillaria, then we may be assured that the posterior commissure, as it is called, is an arrangement by which the special perceptive oli-versal filaments from the grey tissue of the right optic thalamus pass to the edge of the left crus cerebri and the left olivary ganglion, and *vice versa* :—for the general law of transition and combination of the special perceptive oli-versal fasciculi, conducting special perceptive influence from the grey tissue of the distal organs of impression of the apparatuses of perceptive consciousness, must be without exception. But, according to M. Cloquet, the corpora mammillaria have no commissure made up of medullary filaments ; therefore the posterior commissure of the brain of anatomists must be a transition of special perceptive oli-versal filaments from the grey tissue of the optic thalami to the opposite corpora mammillaria, and opposite crura cerebri, and opposite olivary ganglions. Speaking of the mammillary or pisiform tubercles — “ They are united to each other,” says M. Cloquet, “ by a little grey ribbon, which is easily torn, and which contributes to form the floor of the fourth ventricle : ” — evidently the olivary web of symmetrical grey tissue interposed between the peduncles of the olivary ganglions or the crura cerebri.* Such transition of the special perceptive oli-versal fasciculi, from the grey tissue of the optic thalami across the median plane of the cerebro-spinal apparatus, is in analogy with the special perceptive oli-versal fasciculi from the Schneiderian membranes, the retinae, and the grey tissue of the corpora striata, which all cross

* Dr John Gordon, *loco cit.*, pp. 97, 134. Tiedemann, *loco cit.*, p. 203.

that plane before they join their corresponding secondary ganglions of reinforcement:—the two first at the anterior commissure; the last at the commissure of the optic nerves—before they reach the opposite sides of the tuber cinereum, the symmetrically double secondary ganglion of reinforcement for smell, sight, and for the perceptive functions of the grey tissue of the corpora striata.—I submit these observations on the anatomy and functions of the posterior commissure at present, with diffidence, to the future researches of anatomists, directed by the general laws of this work. Meantime my own observations shall be directed to the perceptive fasciculi of the optic thalami, and the connexion of the posterior commissure with their grey tissue, in the brains of those animals to which I can have access. I therefore hope to be able to clear up this piece of anatomy, to trace its every filament, and bring it under the general laws.

120. It is not difficult to explain how, in accordance with such anatomy, the phenomena of voluntary muscular contraction, and memory, and fancy, are effected. Is the fore-finger, for example, of the left hand to be bent?—a quantity of nervous aura is secreted by a selective impression of the spirit upon that particular patch of grey tissue of the right optic thalamus, which gives origin to the special musculo-olivary filaments proceeding to the right olivary ganglion, and which are there directly connected with the dorsal filaments, constituting a part of the anterior column of the left side of the spinal cord, and terminating in the flexor muscles of the little member before mentioned. The influence, thus conducted to the capillaries of the muscles of this member, stimulates, through their grey sympathetic filaments, the sympathetic ganglions from which the plexuses of the

arteries of these muscles are derived ; so that along the sympathetical filaments, again, a nervous influence is transmitted, by which the same muscles are ultimately contracted.

121. The sight or feeling of the motion of the little member is the perception of the act ; and the memory of the act is effected in the same manner as the act itself : only the selective impressions of the spirit, to produce the memory of the motion, are much less considerable than those to produce the voluntary muscular contraction which causes the motion itself. This is very finely illustrated in the dream of the dog as he lies on the hearth. While the consciousness of the chase is being produced, the feet are observed moving by very slight contractions of the very muscles which move the body so rapidly in the field. Hence it is so dangerous in mono-maniacal homicides, with irritable nervous systems, to think of the murderous act ; the impression of the spirit to produce the thought of the act, being only a little short, in degree of force, of that necessary to produce the act itself. Where the former only was intended, the latter, in such irritable habits, is apt to follow.

122. Now, should the grey tissue of the right optic thalamus, from lesion of itself, or any condition of the right superior cervical ganglion, be rendered unimpressible by the spirit, either as to the contraction of the muscles of the left thoracic extremity, or to the memory of the motion arising from such contraction, then it is evident that palsy of that extremity must follow. But it is evident that the memory of the perception of the motion arising from such contraction must still be retained. It must be understood that the selective impressions of the spirit, subservient to memory and fancy, are made simultaneously upon symmetri-

cally disposed patches of the grey tissue of both the corpora striata or optic thalami. Therefore, although the grey tissue of the right optic thalamus be unimpressible as to the memory of the sight or feeling of the bending of the little finger, the grey tissue of the left optic thalamus will still be so impressible: just as vision is complete with one eye, although the retina of the other is unimpressible as to sight. But if the musculo-contractile influence, after having been secreted in the grey tissue of the right optic thalamus, be impeded in its course to the right olivary ganglion by section of, or pressure upon, the special musculo-olivary filaments, constituting a portion of the right crus cerebri, or, properly, the peduncle of the right olivary ganglion, — or in its course along the anterior column of the left side of the spinal cord, or along the fasciculi leading from this to the muscles of the fore-finger of the left hand, — then palsy of these muscles must also, in this case, be the consequence. Of the mode in which the unspecial and special voluntarily contractile influence traverses the median plane of the cerebro-spinal apparatus, I shall have occasion to speak in a future work, when treating of the dæal apparatus of the olivary and moriform ganglions. The same explanation as here given, *mutatis mutandis*, applies to the grey tissue of the right corpus striatum, considering this as an organ of selective impressions of the spirit, subservient to the voluntary contraction of the muscles of the left abdominal extremity; and the memory of those motions of it which are consequent upon such contractions.

123. Again, is the picture of a tower, formerly seen, to be remembered? — are the selective impressions of the spirit, subservient to the consciousness of such picture, made upon symme-

trically disposed patches of the retinæ, in the same order and relation as the various pencils of light which formerly produced the sight of the material object itself? No: for the destruction of the optic nerves, between the retinæ and the commissure, will not annihilate the memory of things formerly seen. Are such selective impressions made upon the same symmetrical parts of the grey tissue of the tuber cinereum? No: for in that case of Mr Travers', where the course of the perceptive influence, reinforced in that grey tissue, was impeded along the inner edges of the crura cerebri, there is no doubt but that the memory of sight was still retained. The selective impressions, therefore, of the spirit, it is presumed, are made upon the grey tissue of the corpora striata or optic thalami, simultaneously and symmetrically on both sides, just as those of the variously coloured pencils of light, from a presently seen material object, are made upon corresponding patches of both retinæ:—so that in both cases the consciousness of the sight of only one image is effected.

124. Hence, supposing that the grey tissue of the right corpus striatum or right optic thalamus is unimpressible, by the spirit, as to the memory of sight; or that the perceptive influence, when generated there, is impeded in its progress to its ultimate versal destination in the cerebro-spinal apparatus along the medullary filaments at the inner edge of the left crus cerebri to the left olivary ganglion:—still, if the grey tissue of the left corpus striatum or left optic thalamus be impressible as to such effect, and the influence, generated there by selective impressions of the spirit, have a free course along the medullary filaments at the inner edge of the right crus cerebri, the memory of sight will be effected—the image of the tower will be remembered. To

produce perfect annihilation of memory as to sight, therefore, the grey tissue of both corpora striata, or both optic thalami, must be unimpressible, or else the perceptive influence, after having been generated there, must be interrupted in its course along the edges of both crura cerebri to both olivary ganglions. It is evident that, since the impressing agent, the spirit, is imperceptible in its operation, no man can tell whether its impression is made upon the grey tissue of one or both corpora striata, of one or both optic thalami; just as no man could tell on which retina the various pencils of light impinged, if they could impinge when the cyclids are shut. It is by touch and sight alone, that we come to know that there are two retinæ, and pictures from objects symmetrically painted upon both.* But Nature has formed the grey tissue in question remarkably unimpressible as to touch; and if any change were perceptible in it on an impression of the spirit, such change is out of the reach of our observation. The same reasoning, *mutatis mutandis*, applies to the memory of smell, hearing, taste, and touch. As these perceptions are effected by secretions from impressions of matter, so the memory of them is effected by secretions from impressions of the spirit.

125. Again, if the picture of an object is to be fancied; the selective impressions of the spirit cause the same combination of secretions in two symmetrically disposed patches of the grey tissue of the corpora striata or optic thalami on both sides, as the pencils of light would do upon symmetrically corresponding patches of the two retinæ, were the object fancied, seen. As the impingements of pencils of red rays upon certain symmetrically

* Bouillaud, *Encephalite*, p. 662.

situated spots on the retinae, by their vibration, give rise to the secretion of a particular aura, to be simultaneously transmitted to the organ of perceptive consciousness to cause sight of the red spot of a material object; so the influence, transmitted by the spirit from its residence in the semilunar ganglion, along the sympathetic ganglions of both sides and the sympha-déal filaments from the superior cervical ganglions, eliminates, from symmetrically situated spots of the grey tissue of both corpora striata or of both optic thalami, an aura, which, being simultaneously transmitted to the semilunar ganglion, causes the sight of the red point of the object fancied. As the impingement of the variously coloured pencils of light upon the retinae are determined by physical laws; so the selective eliminations of the spirit are determined by the intelligence of this alone, with the view of producing a combined variety of secretions, to imitate those caused by the various pencils of light proceeding from the object fancied, if it were really outwardly seen. But before the selective eliminations of the spirit are operated, the combination of the various elementary parts of the picture must be effected by the intelligence of the spirit itself. This is the treasurer of its own perceptions, and it is it alone which can renew these perceptions, and combine them in different ways, to produce the phenomena of memory and fancy. Thus the objects remembered and fancied by the spirit itself, are manifested to man, considered as a compound being, by the medium of material vegetably living apparatuses. Thus we see how minutely and intimately acquainted the spirit must be even with the most intricate and complicated parts of the human body. As light may be said to be the panoramic painter of the material universe upon the retinae, so the spirit of

man may be said to be the panoramic painter of scenes, formerly seen, and presently remembered or fancied by it, upon the grey tissue of the corpora striata or optic thalami. And as, when the secretive canvass for the pictures of material objects is no longer fit to be wrought upon, these objects are no longer visible ; so, when that for those of spiritual objects is in the same condition, these latter objects can no longer be remembered or fancied.

126. But how, it may be asked, can we be assured that the functions of the grey tissue of the corpora striata and optic thalami are such as have been here attributed to them ? It may be answered, partly by the special versal filamentous appurtenances belonging to such tissue, and proceeding from it to the primary cerebro-spinal ganglions, according to the general laws of combination and transition above pointed out ; and partly from pathological observations. It may be assuredly relied upon, that the grey tissue of the optic thalami, as well that of the corpora striata, are organs of impression subservient to voluntary muscular contraction, from the special musculo-oli-versal filaments from such tissue, combining with the unspecial musculo-oli-versal fasciculi conducting unspecial musculo-contractive influence from the grey tissue of the cerebral convolutions, and so passing with these fasciculi to the corresponding olivary ganglions,—according to the general law of combination, of special with unspecial fasciculi. Again, we may be convinced that the grey tissue of the corpora striata and that of the optic thalami are organs of impression subservient to perceptive consciousness, from the impressions of some imperceptible intellectual agent in man, from the conformity of the special perceptive oli-versal fasciculi which proceed from such tissue, with the general laws of combination

and transition observed of such fasciculi proceeding from the distal organs of impression of the apparatuses of perceptive consciousness from material impressions. Furthermore, we may be assured that the grey tissue of the corpora striata and optic thalami are organs of impression by some agent, from the protective versal fasciculi proceeding from them, to join, according to the law of combination, the unspecial protective versal fasciculi from the unspecial grey tissue of the cerebral convolutions. Thus the beautiful general laws of the cerebro-spinal system of nerves assure us of the functions of organs of impression acted on by an agent that is itself imperceptible.

127. Pathological conditions, both naturally and artificially induced, also tend to corroborate the views laid down of the functions of the grey tissue of the corpora striata and optic thalami. There is a beautiful experiment of deprivation, wrought by the hand of disease, detailed by Professor Andral, wherein, from the ventricular surface of the right optic thalamus, the grey tissue of this was gradually destroyed by softening, and where the left arm alone was palsied.* M. Laerampe Loustau also furnishes an instance, where there was paralytic weakness of the right arm, and where a cavity was found after death in the middle radiations of the left optic thalamus. The same author gives a case, where there was palsy of the left abdominal extremity, and where, after death, a sanguineous clot was found in the right corpus striatum.† Such instances would seem to show, that the grey tissue of the right corpus striatum and right optic thalamus are, respectively, subservient to the voluntary contraction of the

* Andral, *loc. cit.*, p. 435.

† Revue Medicale, Mars, 1824.

muscles of the left abdominal and thoracic extremities. Doubtless there are cases, where lesion of the tissue of any part of one hemisphere gives rise to palsy of both extremities of the opposite side, from the effects of irritation of the sympa-versal grey filaments of the corresponding superior cervical ganglion upon its secretive functions ; just as ulceration of the stomach would impair the secretive power of the semilunar ganglion. The slicers of the brains of the lower animals tell us, in an unprecise way, that their victims walked about after their cerebral lobes were cut off. But have these experimenters ever observed a dog voluntarily walk about, with judgment and observation, if his corpora striata and optic thalami had been, by an incision, isolated from the olivary ganglions. No. "Our authors (Flourens and Rolando) do not always observe due precision in describing the exact seat of the section of the cerebral lobes ; and it is likely that even trivial deviations will cause essential differences in the phenomenon. Majendie remarked, that if the section was made immediately before the optic thalami, and not at a short distance before them (as in his experiments just noticed), the vigorous motions of the animals were at once suspended, they fell down on the side, the head was drawn back, and the limbs became rigidly extended. Rolando, who generally made his section at the same point, seems also to have occasionally observed catalepsy ensue. Majendie farther adds, that when the seat of section was then carried backwards, so as to remove the optic thalami, the limbs regained their suppleness, and the head its straight direction—motion, however, continuing suspended. From these facts, he conjectures that the optic thalami are somehow connected with the power of motion ; and he proposes to commence an

inquiry, with the view of determining the nature of this connection."* Here, then, is the capability of voluntary muscular contraction abolished from the isolation above contemplated.

128. It may be said that balls have lodged in the human brain, and yet the individual has walked about, seemingly in the possession of all his faculties. True ; a ball may lodge, for example, in the medullary tissue of anastomoses at the bottom of the cerebral convolutions, and such be the case ;—because, while there, it only interrupted the transmission of so much unspecial influence, that was generally subservient to all the functions of the olivary ganglions ; but still a sufficient quantity of that influence was secreted by the unspecial grey tissue, and transmitted by the medullary filaments leading from it, that were left uninjured, as to be quite competent to the carrying on of these functions.

* Edin. Med. Journal, vol. xxi. p. 150.

END OF PART I.

ANNAN :

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ERRATA AND ALTERATIONS.

- Page 3, l. 17, for "*quille*" read "a pin."
 — 35, for "nihilominus" read "nihilominus."
 — 44, l. 17, supply two inverted commas at the end of the line.
 — 63, l. 7, for "longer," read "larger."
 — 75, l. 6, for "carotid" read "internal carotid."
 — 86, l. 7, for "ganglion" read "ganglions."
 — 102, l. 18, to the sentence ending this line, add, "and the special protective mori-versal filaments of the organic order from the grey tissue of the right corpus striatum and right optic thalamus."
 — 112, l. 25, for "protective" read "perceptive."
 — 124, l. 9—N. B. These olivary fasciculi are also composed of special protective oli-versal fasciculi from the apparatuses of hearing, of taste, and of touch.
 — 139, l. 5, *dele* "Human."
 — —, l. 18, *dele* "of Gasser."

Even while this work was passing through the press, newer and truer, simpler, and more elegant conclusions presented themselves, affecting some propositions which had already been printed. Consequently the reader is requested to make the following alterations with his pen before he begins the perusal of the work:

When the third sentence in art 24, p. 37, was thrown off, I was not so well aware where the perceptive influence impressed the soul of man, and could trace that influence no farther than the corpora olivaria. But, subsequently, I came to the conclusion that it reaches the semilunar ganglion. Therefore, for the above sentence, read "The olivary ganglions are those to which the influence subservient to perceptive consciousness is carried by cerebrö-versal filaments."

As I have explained at p. 101, when the division of the work which treats of the unspecial versal apparatuses of the olivary and moriform ganglions, was thrown off—on account of the intimate connexion of the special protective mori-versal filaments of both orders, forming the right and left pillars of the Vieussénian valve, with the unspecial protective oli-versal fasciculi—the right and left tæniæ semicirculares, and the right and left pedicles of the pineal gland—I thought that the unspecial protective influence from the right hemisphere, for example, passed to the right and left moriform ganglions. I had reason afterwards, however, to alter this opinion, and to arrive at the more simple and elegant conclusion, that the grey tissue of the convolutions of the cerebral hemispheres secretes an influence subservient to the functions only of the olivary ganglions, and that that of the convolutions of the hemispheres of the cerebellum secretes an influence subservient to

the functions of the corresponding moriform ganglions :—the unspecial perceptive influence from the convoluted surface of the right cerebral hemisphere passing to the left olivary ganglion—the unspecial protective influence from the same source, to the right olivary ganglion. According to this more simple view, the special protective oli-versal fasciculus from the grey tissue of a distal organ of impression of an apparatus of perceptive consciousness, will combine with the corresponding unspecial protective oli-versal fasciculus passing to the same olivary ganglion ; and a special protective mori-versal fasciculus from the same organ, will combine with the corresponding unspecial protective mori-versal fasciculus passing from the plicated grey laminae of a hemisphere of the cerebrum to the same moriform ganglion.

Therefore the following alterations are requested to be made by the reader with the pen, before he begins the perusal of the book :

Page 45, l. 22 and 23, *dele* “ and moriform.”

— 46, l. 9, 10, and 11, for “ subservient to the protective functions conjointly of the olivary and moriform ganglions, passes to these ganglions on the right side,” read “ subservient to the protective functions of the right olivary ganglion, passes to this primary nervous centre.”

— 65, l. 1, for the remainder of this paragraph after the colon, read “ ; which passes to the right olivary ganglion.”

— 46, l. 21 and 22, for “ the unspecial as well as special protective influence secreted in the grey nervous tissue,” read “ the special protective influence secreted in the special grey nervous tissue.”

Any one acquainted with the difficulty of these researches; will easily forgive the oversight which has given rise to the above alterations. But my own conscience would scarcely have forgiven me, if I had omitted to notice them. The last of them depend upon a great and fundamental law in the nervous economy, that primary ganglions do not communicate by versal, but deal filaments, and that when two or more primary ganglions send their several influences to the same organ of effect, it is by an anastomosis of deal filaments in a plexus originating from such ganglions.

